ENGINEER, ARCHITECT AND SURVEYOR.

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INTER-STATE INDUSTRIAL EXPOSITION OF CHICAGO.

The second annual exhibition opened on the 9th ult. and closed on the 10th inst., being pronounced a very great success equally by all who visited, and all who were interested in it; a success greater even than that of last year.

The Board of Directors and Officers comprise the names of some of the leading merchants and prominent business men of Chicago, which fact alone would be a guarantee of its success, both in conception and management. The officers for this year were Potter Palmer, President; J. Medill, Hon. C. B. Farwell, W. F. Coolbaugh, J. Rosenberg, and N. K. Fairbank, Vice Presidents; J. I. Pearce, Treasurer; J. P. Reynolds, Secretary; Executive Committee, N. S. Bouton, Chairman, Potter Palmer, G. H. Laflin, R. T. Crane, J. B. Drake, G. S. Bowen, E. L. Brown, D. A. Gage, T. W. Harvey, and J. I. Pearce.

The Exposition Building, of which we give an illustration herewith, is almost the largest, and decidedly the handsomest of its class in this country, and was erected last year in the almost unprecedentedly short time of 88 days, including the time occupied in driving the piles forming the foundations, for its site is all "made ground," being situated in the Lake Park, which was all formerly under the waters of Lake Michigan. In consequence of increased demands for space this year from fresh exhibitors, the company built, this summer, the hall at the north end for agricultural machinery and implements, the conservatory at the south end, three additional rooms for works of art, and enlarged the restaurant.

The main portion of the building is 800 feet long and 220 feet wide, and has a continuous gallery 50 feet above the main floor running round the inside, the total area of the two floors being 206,000 square feet or 4.73 acres. From the floor to the ridge of the roof measures 165 feet, and to the top of the main cupola over 200 feet. The agricultural hall measures 270 feet by 100 feet. The conservatory consists of a projection 100 feet long by 45 feet wide, with two wings 60 feet by 25 feet each. The Art Hall consists of six rooms and has an area of 120 feet by 90 feet, and a hanging surface of more than 50,000 square feet. The restaurant consists of two rooms, one built last year 240 feet long by 20 feet wide, and the addition of 100 feet long

and 15 feet wide, made this year. The art gallery, restaurants, and boiler house, are all situated on the east side of the building, facing the lake.

The total length of the building is 1000 feet, and it is compactly and systematically arranged, all under one roof. The precautionary arrangements against fire are well designed, there being nine fire hydrants placed at equal distances round the building, with ample lengths of hose supplied to each. Coils of hose were laid also along the whole length of the roof just underneath ridge lights, and at a recent trial the whole roof was flooded in the short time of four minutes! In a small building erected on the breakwater at the edge of the lake, a Cope & Maxwell's steam fire pump, belonging to the Exposition Company, was kept constantly in action, supplying water to the 4″-main, at a pressure of 80 lbs per square inch, which could be increased to 200 lbs. At a trial of the pump water was thrown over the flagstaff on the central cupola of the Exposition, this being 100 feet above the nozzle of the hose-pipe, and more than 260 feet above the pump. The pump was situated 300 feet from the main building, and supplied sufficient water for a town of 2000 inhabitants. A fire engine with a full company, belonging to the city, was also kept in readiness among the exhibits in the Exposition.

Though, we are glad to say, no necessity arose requiring the services of the fire apparatus, yet the managers of the Exposition deserve all praise for the precautions taken. The general appearance of the building, both externally and internally, is handsome and imposing, and that of one admirably adapted to the purpose for which it was designed, the interior being remarkably free from obstructions, and the roof (main principals, braced timber ribs, segmental in form, and tied at the feet with wrought-iron tie-rods) of light and elegant appearance.

To a thoughtful mind the immense benefits derivable from these Industrial Expositions are almost incalculable, both to the exhibitors themselves and the visitors. The former not only advertise their business and manufactures, but by comparison with and among themselves, they see the progress made in the same branches by other manufacturers, almost every exhibitor generally finding some one among his fellows who excels him in some particular part of his own manufacture, and being thus lead by a healthy spirit of rivalry to emulate and surpass if possible, the other's achievement. An Exposition thus promotes an open competition which has ever proved to be most advantageous to the competitors themselves as well as the public generally. By inspecting other portions of the Exposition besides the part devoted to their own trade or manufacture, they learn much in common with the general visitor, thus enlarging their mental capacities and raising their minds from the narrow groove into which too long and exclusive an occupation of one kind, is apt to lower them.

On the general visitor also the stimulus given to his powers of observation and analytic thought, is most beneficial; not alone by him and his friends is this benefit attained, but by the whole nation at large, for as a necessary consequence of the visit, the discussion with others of the various processes of manufacture, arts, natural products, &c., which he has seen, extends by multiplication of the individual throughout the whole country, rapidly and materially aiding in promoting and developing those habits of thought and enquiry which have ever been the characteristics of the most progressive people.

The great and rapid strides made by many European nations in the arts and manufactures, during the last 20 years, are most clearly effects of the great exhibitions held on that continent. The first, and in many respects, the greatest, was the Great Exhibition at London in 1851. This was followed in 1855 by that at Paris, and again in 1862 by the Great International Exhibition at London, this last being followed in its turn by the Exposition Universelle of Paris in 1867. Exhibitions thus increased in number with great rapidity. Brussels, Berlin, Marseilles, Florence, Havre, Lisbon, and Rio Janerio, with other cities, all had their displays, and the great Exposition of last year at Vienna is still fresh in our memories, with, we are sorry to add, the meagre display made there by the United States.

So important as a means of self-improvement, did Great Britain consider these expositions, that the Commissioners of the Great Exhibition of 1851 (a Board which sits permanently,) organized an annual series of International Exhibitions, to be held at South Kensington, London, and erected special buildings for the purpose. The fourth of these annual exhibitions has just been closed. Great though the benefit must be from them to the nation at large, we are bound to add that they have not proved such a financial success as in the opinion of the Commissioners to justify a continuance next year.

Turning from these general considerations to those of our Chicago Exposition, we find the exhibits classified under five departments, lettered A to I, as follows:

A—Fine Arts; B—Liberal Arts; C—Instruments and Machinery of the Useful Arts; D—Useful Minerals, their wrought and cast products; E—Textile Fabrics and Materials; F—Household and Personal Goods; G—Agricultural and Horticultural products; H—Food, Drinks, and Tobacco; I—Natural History.

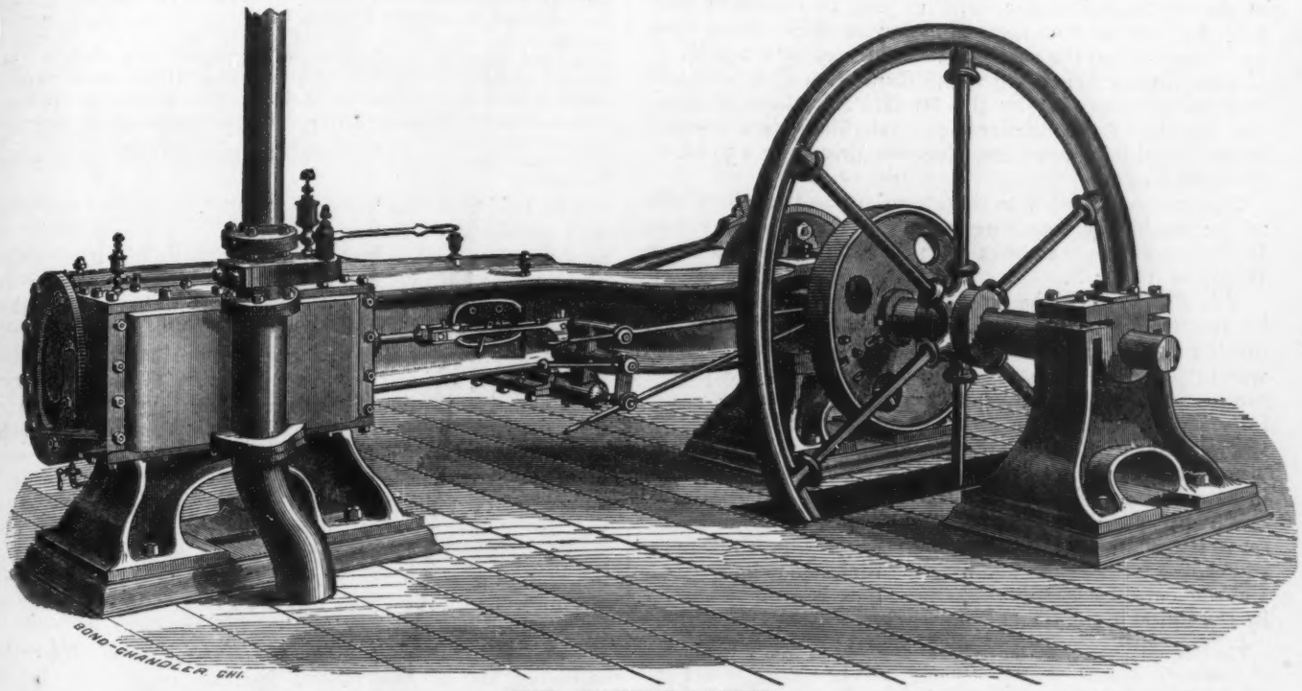
These departments were all subdivided into various sections, and we congratulate the Executive Committee on the well considered and systematic plan which they conceived of for their catalogue. We should have preferred a somewhat closer adherence to this system in the distribution of the machinery on the floors of the Exposition; that is, that all the manufactures and machines of one kind had been grouped together, rather than that all the machines of one exhibitor were to be found together, which was the case.

Prior to a detailed consideration of Departments, C and D, under which head all exhibits of engineering interest were to be found, a few general remarks upon some of the other departments may be of interest to our readers.

In Department A were some 700 paintings, a few photographs and pieces of sculpture. The paintings chiefly represented the modern French, German, and Dutch schools, and some charming cabinet pictures were on exhibition, as well as some very good productions of a more ambitious character. We heartily congratulate the Art Committee on one of the best, if not *the* best exhibition of paintings ever collected together in this city. In Sec. 2 of this Department were some fair specimens of statuary, and a case of some very good wood engravings by Vandercook & Co., of this city, also wood engravings by the Chicago Engraving Company.

Department B, in its various sections, was an exhibition of stationery, books, musical instruments (among which were two magnificent Chickering pianos, the one a grand, the other an upright), medical instruments, and surveying and mathematical instruments.

Departments E and F, being solely devoted to dry goods, wearing apparel and house-furniture, presented little of interest to the mechanical mind; it should be mentioned, however, that in the latter there were very good exhibits of furniture carvings, brackets, and scroll-work by H. H. Andrews & Co., of 211 Wabash Avenue, A. H. Wiser & Co., of 216 W. Lake Street, and Smith & Winter, 648 Throop Street. Department F also combined Jewelry, Ornaments, fancy and toilet articles, watches, &c., in which latter section the Elgin Watch Co., with their elegant octagonal stand, and Cornell Watch Co., whose stand was a large and perfect model of their factory, both attracted much attention from the visitors, as they had staffs of em-



THE BUCKEYE ENGINE.

ployees at work in the various branches of watch manufacture.

Department G, section 1, did not we feel bound to say, give anything like an adequate idea of the splendid agricultural, horticultural and mineral products of the great West. The deficiency of the two former articles may have been owing in part to the perishable nature of the materials, and in part to the time of the year, but there seems no excuse for the small number of exhibitors (10), among whom no less than six were land-grant railroad companies, and two out of the other four, exhibitors from Rochester, N. Y. We shall give further and extended mention of the mineral products in this article, and only remark here that we earnestly hope that great improvement may be noticed in this Department next year. Section 2, flowers in bloom, and aquaria in the conservatory at the south end of the Building, was much better in this respect than section 1, and reflected very creditably upon the taste of our gardeners.

Department H comprised articles of food of easy preservation; this term apparently did not apply to the products of the stands where candy and cigars were manufactured, for we noticed very rapid consumption of these articles as soon as produced, especially the former; "choice wines and liquors" were also exhibited but not "to be drunk on the premises."

We hope next year to see a much greater variety and number of exhibits in Department I. The Indian curiosities were almost entirely confined to a number of photographs (very well taken for the most part), of the cruel and brutal Apache, cheifly of the female sex unhampered by superfluous clothing. Modern Indian weapons, and ancient flint arrow-heads, &c., were noticeable only by their absence. Some interesting petrifactions were exhibited by H. Y. Meinhard, Troy Grove, Ill., and a neat collection of shells by J. M. Reynolds, 199 LaSalle Street, Chicago. From this general sketch we now proceed to a more detailed notice of the exhibits in Departments C and D, and a few others, premising with the remark that all the Illustrations given, are those of articles which were actually on exhibition at the late Exposition.

SURVEYORS' AND DRAWING INSTRUMENTS.

In Section No. 4 of Department B, Messrs. Nickel & Strassberger, and L. Manasse were the only exhibitors; we wish that others of our instrument makers had also been represented.

Nickel & Strassburger, 147 *LaSalle St.*, exhibited three well finished surveyors' instruments; 1st, an engineer's transit with 6″ plate graduated to half-minutes and 4⅝″ needle, telescope fitted with attached level and clamp and tangent screw; 2nd, a 17½″ Level, and 3rd, a 6″ Surveying Compass. These instruments each presented some good points worthy of special notice. The Transit and Level were fitted with long compound centres resting at the foot on a small spring capable of nice adjustment which relieved the friction on the centres and prevented the *binding* which occurs when lubricating oil runs dry. The centres and parallel plates also are fitted together in one piece which lessens the liability of the instrument to get out of adjustment. The compass was fitted with four adjusting screws at the ball and socket joint which enabled it to be leveled with as much precision as by a pair of parallel plates and screws, a very good idea. An arrangement was also fixed on the vertical sights whereby the compass could be used for levelling.

L. Manasse, 88 *Madison Street* exhibited a good assortment of moderate priced french and german drawing instruments, some in electrum and some in brass; they looked serviceable and were cheap, two great inducements to many surveyors whose funds are limited.

We regret that there were no more exhibits in this Section of Department B than those above mentioned, we should especially have liked to see there some highly finished drawing instruments.

Some few electrical, and medico-electrical instruments were exhibited in this Department for which we have only space for this passing notice.

STEAM ENGINES, BOILERS, AND THEIR APPLIANCES.

The line of shafting from which all the machinery was driven, was in aggregate length, 860 feet, there being one length of 240 feet in the Agricultural Hall, driven by F. C. Well's 45 H. P. Engine, a circular line of 140 feet long

at the north end of the building, and two straight lines each 240 feet long on the east and west sides of the main building, that on the east side being driven by a 250 H. P. Corliss Engine belonging to the Exposition Company, and that on the west side by the 80 H. P. Buckeye Engine; the lengths of the circular line of shafting were coupled by universal joints, and the line was driven by a 50 H. P. Douglas Engine.

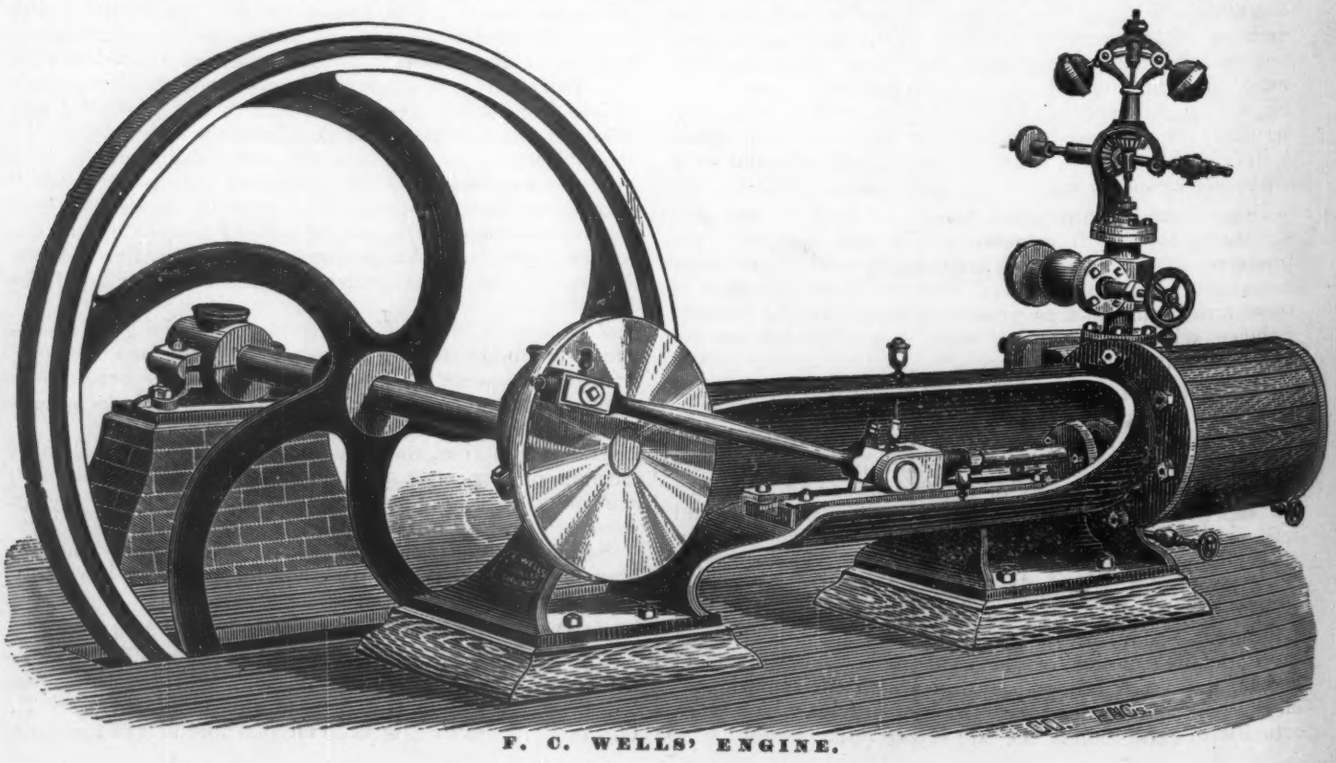
Steam was supplied to these engines and for the whole of the machinery requiring it in the Exposition by two Boilers; the one a Babbitt of 230 H. P., the other a Root Boiler of 192 H.P.

The Buckeye Engine illustrated on page 119 manufactured by the Buckeye Engine Co,. Salem, Ohio, showed good finish and ran very smoothly and noiselessly. The cylinder was 14″ dia., and 24″ stroke, and with 80 lbs. of steam running 125 revs. per minute gave 81 H. P., we were not informed at what grade of expansion the engine was worked but this would correspond to about 1-5th the stroke. The peculiarity in this engine consists, as will be noticed, in its valve and valve-gear, the cut-off valve being governed entirely by an automatic disc-shaped governor keyed on to the main shaft, as shown in the engraving. The main slide valve works close against the casing and cylinder-face, and the cut-off valve works within it as is well described by the following extract:

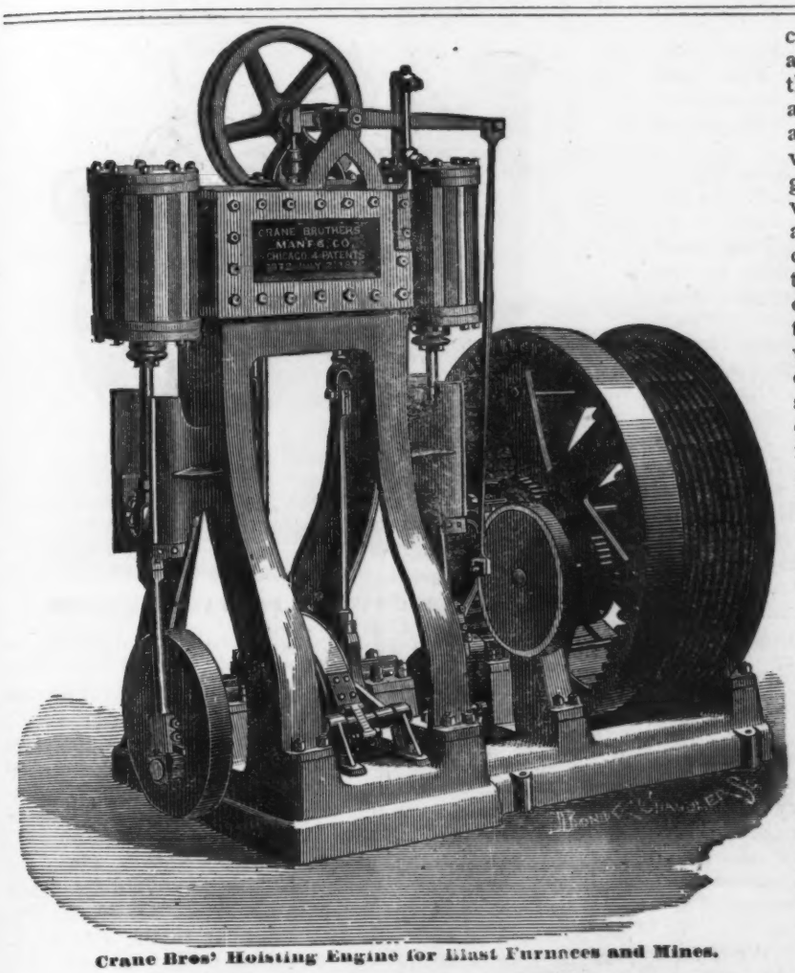
The steam is admitted to the cylinder *through* the slide valve instead of *around* it. It enters the valves through circular openings in its back, and is admitted from thence to the cylinder through two ports, which are alternately brought to coincide with the cylinder ports. The exhaust takes place at the *ends* of the valve, instead of through a cavity under it. The steam, when released, passes directly through the ends of the steam chest, and through ample passages into the exhaust pipe seen in the cut passing downwards. The openings in the back of the valve, besides admitting steam to its interior, also serve to furnish the pressure which holds it to its seat, and, as they are made of just sufficient area to accomplish this purpose, the valve is as nearly balanced as is practicable with any form of valve in use. The cut-off valves are contained *inside of the main valve*, and alternately cover the ports from which the steam passes into the cylinder. They are actuated by an eccentric on the main shaft, the position of which is under the control of the centrifugal force of the pivoted weights contained in the circular or pulley-shaped case seen on the engine shaft. The main valve is operated by a fixed eccentric placed alongside the adjustable one. By means of the novel compound rock-shaft arrangement (shown in the lower cut) through which motion is transmitted from the eccentrics to the valves, the movement of the main valve is prevented from distorting or in any way disturbing the movement of the cut-off valves inside of it, the cut-off taking place at any point from zero to half stroke, as may be determined by the load on the engine, or the pressure of steam in the boiler. The engine is very closely governed, and uses steam with the highest economy; consequently it is particularly adapted to flouring mills, as well as to all purposes where a uniform speed is desirable, and to locations where fuel is expensive.

The Indicator diagrams shown were excellent; cut-off at 1/16th stroke with 60 lbs. for initial, and atmospheric for final pressure, and average piston pressure of 21 lbs., boiler pressure, 61 lbs., very small amount of compression or back pressure shown, and remarkably uniform expansion from the cut-off to end of stroke. About ½ as much clearance is required in the ports as in the ordinary slide valve engine, and the economy in fuel is ⅓ more than can be obtained with the best form of throttling engine. The Buckeye Engine Co. also exhibited two small portable engines attached to vertical tubular boilers of neat and serviceable appearance and ordinary type Of these are manufactured 4 sizes which at 200 revs. per minute, give 1¼, 2½, 5 and 10 H. P. respectively; exhaust steam can be used as a blast to the boiler fire; the 1¼ H. P. boiler has a single 6″ flue, the other sizes have 2″ tubes, 19, 37, and 61 in number respectively; a 15 H. P. Boiler is also kept in stock which has 91 tubes, 2″ dia. and 25″ long.

F. C. Wells, 116-122 *South Clinton Street*, *Chicago*, exhibited the engine shown by the illustration below which represents the engine driving the whole of the agricultural machinery. Though 60 H. P. was called for, this 45 H. P. engine did all the work required with the greatest ease. The size of the cylinder is 14″ dia. and 22 ins. stroke, and gives 45 H. P. at 100 revs. per min. The valve used is a common double D slide, but proportioned and designed with special care by which, and carefully designed steam and exhaust ports, much economy is effected over the ordinary slide-valve. The frame of the engine is so constructed as to confine well within itself all strains which arise, and thus with the liberal bearing surface given in the cross-head guides the



F. C. WELLS' ENGINE.



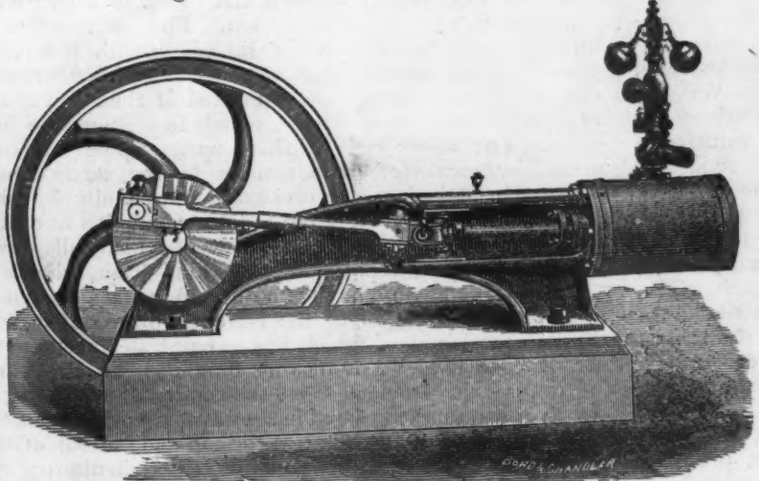
Crane Bros' Hoisting Engine for Blast Furnaces and Mines.

engine can be run very steadily at high speeds, and with little wear. These bearing surfaces are exceptionally large (96 sq. in. on the bottom, and 48 sq. in. on the upper surface in the 45 H. P.), and a simple provision is made on the under side of the cross-head slide for taking up such wear as may occur.

Frank Douglas Machinery Co., 253-5 *South Canal Street*, *Chicago*, exhibited the engine which drove the circular shafting. The cylinder was 12″×24″, and the peculiarity of the engine consisted in its automatic cut-off and rotary valves, which are difficult to explain without the aid of drawings. The admission valves were vertical cylinders placed at the sides of the cylinder, and the exhaust, horizontally at the bottom of the cylinder and transverse to its axis. The admission valves have a long slot in their length and on the inside surface a curved groove in which work the cut-off valves, and they are given a continuous rotary motion by mitre wheels driven from a bevel pinion gearing into a bevel wheel on the main crank shaft. The cut-off valves communicate direct with and are thus actuated by the governor. The slotted form of the main valves causes the steam to press them closely against their port face, and the wear is of course uniform throughout; the indicator cards are among the best we have ever seen, they show great sensitiveness and very quick cut-off and exhaust; as rapid a cut-off in fact as in the Corliss engine. This Company also exhibited a small Baxter portable engine, which drove a rotary pump; the cylinder of the Baxter engine is enclosed in the boiler-shell, and thus loss of heat from radiation is entirely prevented.

Gibbs & Sterrett Manufacturing Co., 24 *South Jefferson St.*, *Chicago*, exhibited one of their 12 H. P. balance valve engines; cylinder 8″×12″. These engines are fitted with double piston slide valves actuated by link-motion, being thus reversible; the bed-plate is of the ordinary kind, and the cross-head runs between guides bolted thereon. The engine at the Exposition was well finished, neat and compact. We understand that a largenumber of these engines are in use in the oil regions where they have given great satisfaction. This firm also do an extensive business in boring artesian wells, and manufacturing the tools necessary for the same, but they intend to dispose of this branch of their business, in order to devote their attention exclusively to the manufacture of the above described engine, their cylindrical tubular boiler, and mowers and reapers; on the engines and boilers they already employ 100 men, and 130 men on the mowers and reapers. Sizes of engines so far manufactured are from 5 to 100 H.P., and Boilers from 10 to 100 H. P.

Crane Bros. Manufacturing Co., 10 *North Jefferson Street*, *Chicago*, exhibited two of their well-known hoisting machines. The one drove the passenger elevator at the north end of the main hall, which was extensively used by the visitors. Its cylinders were 8″ dia. and 10″ stroke, and the piston rod cross-head ran in guides bored in the same frame and in the same time as the cylinder head. The whole engine and machine was very finished, neat and compact; this class of hoisting machinery is manufactured exclusively for use in buildings as elevators. The other hoisting engine exhibited is illustrated above, it is manufactured entirely for use of mines and blast furnaces. Of these, two sizes are made, the one with 8″×10″ cylinders and single winding drum, the other with 10″×12″ cylinders and two drums. These machines present several points of interest and some novelties, the cross-head guides are curved surfaces bored concentrically, in the same lathe, and at the same time as the cylinder, so that the bearing surfaces are thus made as true as possible, no link motion is employed, reversal being obtained by the use of simple gearing; winding drum is actuated by internal gearing direct from the crank shaft; an automatic stop is provided whereby overwinding, a frequent cause of fatal



Crane Bros. Manufacturing Co.'s New Style Engine.

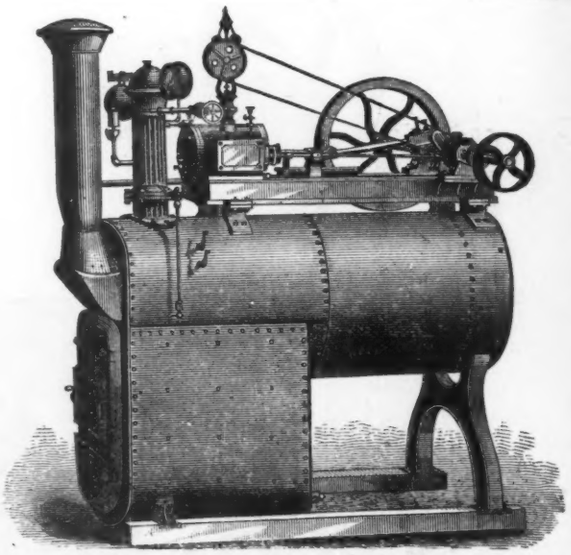
accidents at mines, is entirely prevented. Many well-known Iron and Steel Manufacturing Cos. in this State, Pennsylvania, Ohio, Missouri, Michigan, and Indiana, are using these hoisting engines, we understand, with perfect satisfaction.

This Company also manufactures the "New Style" engine as illustrated on p. 121 of 9, 16, and 25 H. P. In this engine as in the hoisting engines, the cross-head guides are curved surfaces bored at the same time as the cylinder head and concentrically with it. Any wear is taken up by tightening up nuts on two screws, the one on top, the other beneath the cross-head as shown. The piston rod and crank pins are of steel. Fly-wheel turned in the rim to secure its running true. Engine frame of a rather peculiar curved form to transmit all strains direct from the crank-shaft on to the cylinder-head. The finish is that for which this firm is becoming so well-known.

Walworth, Brooks & Co., 243-5 *Lake Street, Chicago*, exhibited three highly-finished small portable vertical engines made by the New York Safety Steam Engine Co., which presented many points showing careful design. These engines of 4, 6, and 10 H. P. respectively were the most showily finished in the whole Exposition, and contrary to most cases of high finish, bore with credit a careful examination. The engine frame is of pyramidal form, bolted at the bottom to a good strong base-plate, and carrying on the top, the inverted cylinder, which is carefully felted and lagged; the pillow blocks carrying the crank-shaft are cast in one piece with the frame. The slide valves are of the double piston variety; brasses in connecting-rod ends made with curved backs to allow of a slight automatic adjustment in case of the axes of cylinder and crank shaft not being at perfect right angles, brasses in the pillow blocks of crank shaft made in the same way; no gibs and cutters in the connecting rod, but brasses are are tighted up by a single set screw and wedge. The wear on the cross-head is taken up in the same way by wedge-shaped sliding-blocks and set screws. We have not space to mention other improvements which these carefully and tastefully designed engines presented, but with a few words concerning the boiler must "pass on." The Boilers are of usual appearance outside, vertical tubular boilers, but in the interior, a baffle-plated and tube is inserted which stops too rapid a circulation of steam upwards along the tube surfaces, and thereby prevents priming. As this prevents the water boiling much above its average surface there is a space in the upper portion of the boiler where the steam becomes partially dried and superheated before going off to the engine. We must characterize these engines and boilers as bearing evidence of specially careful design.

Collins Eaton, 70 *South Canal Street, Chicago*, exhibited the portable or agricultural engines we here illustrate. They were made by the Ames Iron Works, Oswego, N. Y., and are very well known throughout the West as good, substantial, reliable engines. These two engines, one 3 H. P., and the other 12 H. P., were the only exhibits of of this class in the Exposition. The cylinders are jacketted with felt, and lagged with iron; valves, the ordinary slide valve with special attention given to amount of "lap" in its design; larger size of engine fitted with feed water heater placed in the bed-plate; the exhaust steam passes through this heater on the way to the smoke stack. The 3 H. P. engine boiler is fitted with return tubes similar to a marine boiler, to make up for its short length; shortening thus the length of the boiler produces a very handy "portable," taking up comparatively small space in any room or building.

W. F. Moody, 181 *South Jefferson Street, Chicago*, exhibited an ingenious rotary engine, the most practical we have seen, and likely to prove a satisfactory motor where small power is required, especially with the necessity of rapid reversal. This little engine could be reversed almost instantaneously; we can scarcely explain it without the aid of drawings.



AMES' 3-HORSE POWER PORTABLE ENGINE.

The Corliss Engine, made by the *Corliss Engine Co., Providence, R. I.*, which drove the shafting on the east side of the main hall, was a fine example of smooth running. The quick cut-off worked without a jar. The size of the cylinder was 24″×48″.

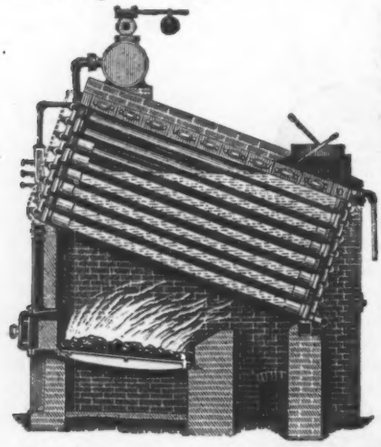
A. E. White, 287 *West Indiana Street, Chicago*, exhibited a model of his valve-less engine; we did not see the construction of the interior, but from the description given imagine it to be somewhat similar to the Frank A. Douglas engine described above, only that instead of a continuously rotating sleeve-valve place on the outside of the cylinder, this engine has a sleeve-valve with a reciprocating rotary motion placed on the inside of the cylinder, moved by cams, actuated by mortises in each face of the piston. It appears to us that the same objection is open as to the common slide-valve, viz: the impossibility of giving various grades of expansion to the steam.

The steam for running the whole of the machinery at the Exposition was supplied as before mentioned, by a 230 H. P. "Babbitt," and a 192 H. P. Root boiler.

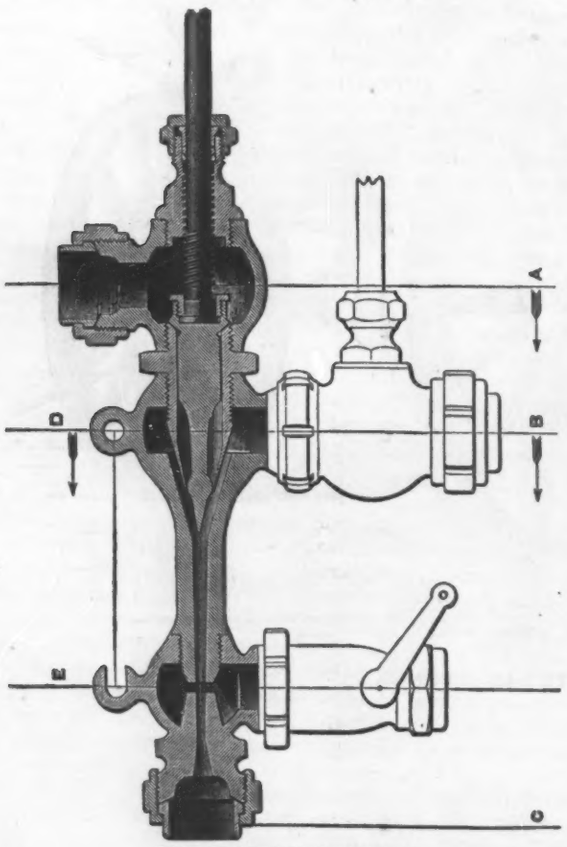
The *Babbitt* Boiler, constructed at the *Whitesboro Iron Works, Whitesborough, N. Y.*, had 788 sq. ft. of fire-grate surface, and it is claimed that 12 lbs. of water were evaporated per 1 lb. of coal used. The construction is multitubular. A series of upright pipes with horizontal pipes attached thereto, and in communication therewith midway of their length, are connected at their lower end to a cylindrical "mud drum" which lies below the fire-grate. The upper ends of these upright pipes are connected by means of smaller tubes to the steam drum. The horizontal pipes are divided longitudinally by pipe diaphrams which prevent too rapid a circulation of heated water, and causes it to deposit sediment which falls down through the upright pipes into the mud-drum, whence it can easily at any time be blown out. A surface condenser of similar construction to the boiler is placed alongside, through the pipes of which the exhaust steam circulates and is condensed. For heating buildings, an airheating apparatus is also provided above the condenser, consisting of short vertical tubes arranged in a series of chambers communicating with each opening at the top and bottom of the chambers alternately after the manner of certain filtering apparatus which is used for water-works; this method ensures

AMES' 12 H. P. AGRICULTURAL ENGINE.

a perfect circulation of air, and a thorough heating from the products of combustion, which circulate around these air tubes, on their way to the smoke stack from the boiler. The boiler in the Exposition occupied a space about 10 ft. × 15 ft. × 16 ft.



The *Root* Boiler is represented by the adjoining illustration and is built by the *Root Steam Engine Co.*, 500 *Second Avenue*, *New York*, their office in this city being 3 West Madison Street. The boiler consists, as will be seen, of wro't-iron tubes 4″ dia., and from 6 to 12 feet long, connected together by a system of triangular plates and crow-feet clamps, and set in brickwork at an angle of 30 degrees which ensures better circulation of the heated water or steam particles, and causes the sediment to collect in the lowest portion of each tube and fall thence into the transverse horizontal tube at the back, whence it is blown off from time to time. The joints are made with vulcanized india-rubber. From the manner of connecting the tubes the passages for the steam are rendered tortuous, and thus it is enabled to deposit most of its water, and become slightly superheated before entering the steam drum at the top of the boiler. This boiler has taken many prizes at various expositions, and is in use in the following countries: United States, England, West Indies, Mexico, and South America. The great advantages of all sectional boilers such as these, consists in their easy transportation, and consequently light freight charges, and in the Root Boiler especially, facility of cleaning, for by simply removing the front plate, the interior of all the tubes is exposed to view. The Root boiler has satisfactorily stood all tests for economy in fuel, capacity for and quality of steam.



MACK'S INJECTOR.

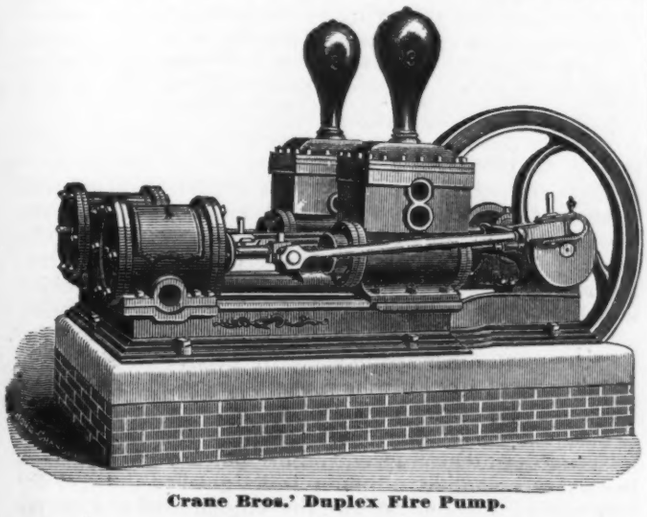
Redfield, Bowen & Co., 112-116 *Lake Street*, *Chicago*, exhibited Mack's Injector, an illustration of which is given herewith. The cut represents a section of the injector as manufactured by the National Tube Works of Boston, Mass., and McKeesport near Pittsburg, Pa. The line *A* passes through the steam pipe, *B D*, through the water-supply pipe, *E*, through the overflow, and *C* is the union-joint between the injector and the feed pipe to the boiler. It will be noticed that the upper rim of the spindle foot is turned in the lathe so as to form a tight valve-face on the surrounding seat, thereby preventing any leakage of steam when the injector is not used. To use the injector for feeding the boiler, the spindle is first screwed back a short distance to allow a small jet of steam to go through the instrument. This rushes straight to the boiler, a small portion only showing at the overflow *E*. A partial vacuum is created around the nozzle at *D*, and and water immediately comes up this pipe to fill it and is carried over by the steam towards the boiler; as soon as it appears trickling down the overflow *E*, a stronger blast of steam is allowed to pass through the injector, which then carries the whole of the feed-water along with it. When the injector is working right, neither steam nor water appears at the overflow *E*; but if either should appear the other is known to be in deficient supply, and the spindle is screwed up or down accordingly; the overflow thus becomes a very accurate guage. The injector, we understand, took the first prize at the American Institute, New York, and Cincinnati, O. The action is continuous, and from its simplicity, reliability and speedy action, we think it likely soon to supersede steam pumps for boiler feeders in many instances.

C. L. Rice, 215 & 217 *Lake Street*, *Chicago*, also exhibited an injector, Rue's patent. In this injector the spindle consists in a moveable tube placed *between* the steam and overflow pipes, and actuated by a hand lever on the outside. By moving this spindle-tube forward, the steam draws the water from the water supply, as in Mack's injector, but by moving it backward, the nozzle of the steam jet fits in a socket on the spindle-tube and the water supply pipe is completely shut off from the steam pipe; the steam then draws the water from a pipe attached to the overflow pipe. This injector will not work with warm water nor draw water from a heater, but will work equally well under either high or low pressures, and is as simple in construction as Mack's injector. Both these injectors are ingenious devices and with care and clean water will work as as well as any pump, and save cost of lubrication and repairs.

Cope & Maxwell, 24 & 26 *South Canal St.*, *Chicago*, exhibited Stillwell's Feed-water Heater, Lime Extractor, and Filter. This is a contrivance for extracting lime from waters impregnated with it, and for filtering and heating the water on its way to the boiler. It consists of a vertical cylinder divided into several compartments by horizontal diaphragms of currugated iron with an opening left in each; the cold water enters by a pipe at the top and flows over each diaphragm until it falls to the bottom of the cylinder, when it rises through a filter of straw to the discharge pipe. The steam enters at the side of the cylinder, part going upward through the down-flowing water, and part downwards to the filter. The water leaves all its lime on these shelves or diaphragms, becomes heated by the steam, and everything in *mechanical* suspension is deposited in the straw filter.

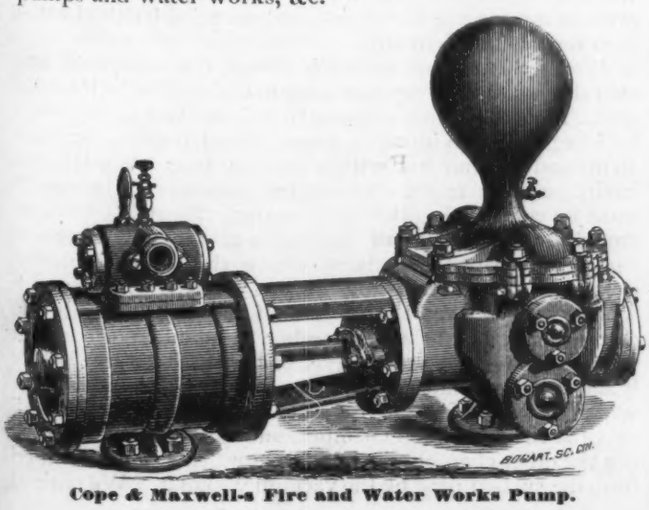
STEAM AND OTHER PUMPS.

Crane Bros. Manufacturing Co. exhibited in addition to their safety hoisting engines, a good assortment of steam pumps of their own manufacture, of which we have selected the Duplex Fire Engine Pump for the purposes of illustration. They manufacture 7 sizes of this pump, giving discharges of from 480 to 1080 gallons per minute in a powerful and steady stream; the pump is well finished and runs very smoothly, and is capable of throwing one

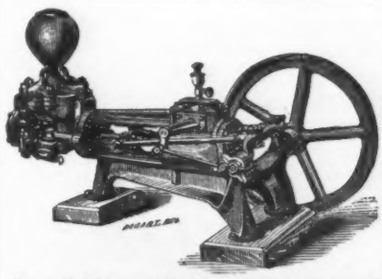


Crane Bros.' Duplex Fire Pump.

1¼″ stream 150 ft. high or two 1″ streams 120 feet high. Their double-action balance wheel pump, and combined engine and pump, are similar in appearance to the duplex pump; the balance wheel-pump, of which six sizes are manufactured, throwing from 60 to 540 gallons per minute; is designed for general use, and the combined engine and pump, of which three sizes are manufactured, throwing from 50 to 240 gallons per minute, is so arranged that the water-piston can be disconnected from the steam piston rod, and the engine then used as a source of power; cross-head and slides, and governor being fitted to it. Their Brewer's Steam Air-pump has 4″ steam and 6″ air cylinder, 12″ stroke. The special steam pump is of similar outward appearance to Deane's pump (which we illustrate), and the steam valve is actuated by tappets on the valve rod in the same way; sizes of this class manufactured are three in number, discharging from 80 to 400 gallons per minute. They also manufacture a low pressure balance wheel pump of three sizes, and every class of fittings for steam-pumps and water works, &c.



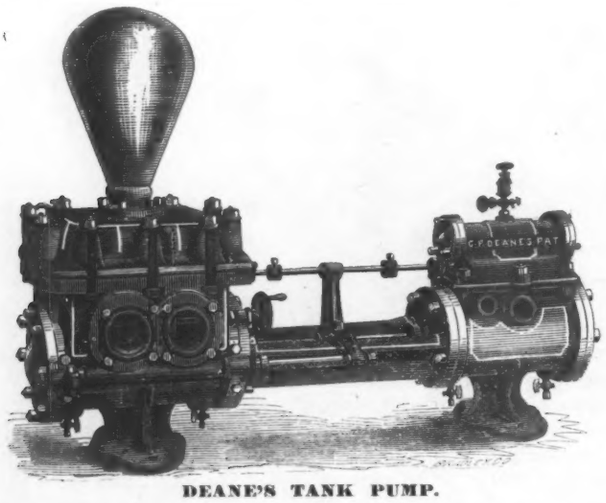
Cope & Maxwell-s Fire and Water Works Pump.



Cope & Maxwell's Power Engine and Pump.

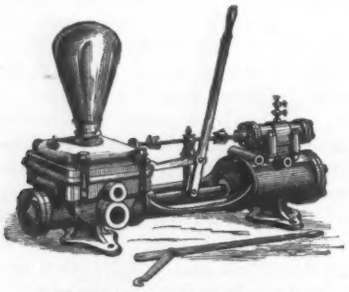
Cope & Maxwell Manufacturing Co., 24 and 26 So. Canal St., Chicago, exhibited a very varied assortment of all classes of pumps of their manufacture unequalled by any in the Exposition, in this respect. They exhibited in all, 11 different pumps, including a very handy little air-pump, and their independent boiler feeder. The large pump illustrated herewith is an illustration of that referred to on page 118 as employed for fire purposes by the Exposition authorities. These pumps are coming rapidly into use for supplying our smaller western towns and cities with water. These manufacturers have recently completed one set of duplex water works pumps for Clinton, Iowa, which will probably be tried about a fortnight hence. The steam cylinders are each 16″ dia. × 30″ stroke, plunger pumps 8″ dia., water main 8″ dia., and their contract is to throw 6 streams 1″ dia., to a height of 125 feet. Sufficient room is left between the pump and cylinder-heads to pack the plunger. A compound engine is also being made to connect with these pumps, with high pressure cylinder, 9¼″ dia., and low pressure cylinder, 16″ dia. stroke 30″, and so arranged that in case of a fire, the low pressure cylinder can be filled and worked with high pressure steam, transforming the engine into a pair of simple engines. There is a hand lever placed between the steam cylinders of the duplex pump, which by a slight movement actuates a valve which separates the two pumps and enables each to be worked independently of the other; this is an arrangement with which no duplex pumps have ever before been fitted. We hope to lay before our readers an account of the Clinton Water Works trial when it occurs. We also illustrate one of Cope & Maxwell's Crank and Flywheel Steam Pumps, made as shown, with return connecting-rods working a double-crank shaft, carrying a fly-wheel. By disconnecting the pumps,the engine may thus be used for power purposes and runs quite steadily when so employed. The Engine frame, slides, steam cylinder, steam chest and crank-shaft, and pillow blocks, are all cast in one piece, and the arrangement of the entire machine is simple and compact. Six sizes of this pump are at present made, with steam cylinders of from 8″ to 10″ dia., pump cylinders 3″ to 7″ dia., and strokes 8″ to 12″. Among other of their exhibits, we must not omit to mention the portable boiler with steam pump attached for use in filling tanks at Railroad stations, Hotels, Bath Houses, &c., which is handy and compact, and their very neat little bucket and plunger boiler feeder which is extremely simple and unlikely to get out of order. The steam valves in the Cope & Maxwell Pump are slide valves of peculiar construction; the water valves are of rubber, kept on their seats by spiral springs, both kinds of valves wear well. This Company also exhibited Heald & Sisco's centrifugal pump.

Redfield, Bowen & Co., 112-116 *Lake Street*, exhibited an assortment of Deane's Steam Pumps of which we illustrate the Tank Pump on p. 126, with boiler feed attached. The steam valves are flat slides; there is a supplemental valve within the main slide-valve so arranged that if by any chance the main valve should stick fast, then the supplemental valve, letting steam into the cylinder, drives forward the valve by main force. A novelty to be noticed on the water-chest, is the way in which the holding-down bolts are fastened through slots in the cover, which enables the valve cover to be lifted off without removing the nuts on



DEANE'S TANK PUMP.

the bolts. Deane's pump is made in as many varities as any other, for feeding tanks, boilers, baths, marine steam pumps, fire engines, blowing engines, mining pumps, &c., &c. Quite a number of these pumps are in use in various buildings in this city.



Knowle's Steam Pump.

C. A. Rice, 215 *&* 217 *Lake Street*, exhibited an assortment of Knowles's Pumps. The steam valves of these pumps are actuated by a tappet arm fixed at one end to the piston-rod, and sliding at the other end on the valve-rod. This, striking at the end of each stroke on one of the two tappets shown in the cut, turns the valve rod partly round upon its axis. The movement thus given to the valves is transverse to the axis of the cylinder, contrary to most cases. These pumps are manufactured in great variety for all kinds of work, and are largely used in many parts of the country. A hand-lever can be attached, as shown, to work the pumps for special purposes, or when steam is not at hand.

Kirkwood & Dunklee, 171 *and* 173 *Lake St., Chicago*, exhibited 7 sizes of Knowles' pumps.

Geo. F. Blake Manu'g Co., 50 *and* 52 *South Canal St., Chicago*, exhibited a number of their well-known pumps, two of which were got up in great style, with nickel plating and brown paint, quite a contrast to the Cope & Maxwells and other pumps working along side. They did a large amount of work however, sufficient to maintain their reputation. As in the case of the Cope & Maxwell Co., this firm exclusively manufactures steam and other pumps for all purposes or "lines;" we do not know, however, of their being in use for the water supply of towns or villages. The steam valve is composed of two slide valves, the one a main valve which fits in its upper part between two collars on a plunger, the other an auxiliary slide and seat for the former. The valves are actuated by a tappet rod fixed to the piston rod, as in the case of the Knowles pump, striking on two taps fixed by keys and set-screws to the valve rod. As the slide valves move they carry with them the plunger which presses against a spring in the plunger cylinder head, and thus gives a quick exhaust to the steam. As the agent here did not consider it advisable to send to New York for cuts of the pump, we are unable to give illustrations of the same.

Smith, Vaile & Co., Dayton, Ohio, exhibited four steam pumps containing novelties in their valve gear, of three makes, the "Cam Pump," the "Atlas Pump," and a crank and flywheel engine and pump. The cam pump is best described without a drawing by the following extract:

> The steam valve is a plain slide valve, worked by means of a cam bolted on the Piston-Rod, and moving with it, and by the shape of the cam, the stroke is slowed down at each end, thereby giving time for the water cylinder to fill, ensuring a full stream every time, and preventing the pump from cushioning against the water when the cylinder is but half filled. It cannot throw the valve in such a position as to shut off steam and stop the pump.

Eight sizes of this pump, as boiler feeders, are made with discharges of from .20 to 12 galls. per double stroke, also two sizes for low-pressure pumps with .20 and .65 galls. per double stroke. In the "Atlas" pump the valve connecting-rod is fastened at its further end to a slide working in a dovetailed groove in a circular disc, this disc being given a reciprocating motion about its axis by an arm working at its other end in a slotted groove on the steam piston rod cross-head; a kind of "dash-pot" arrangement similar to that of the Corliss engine is also fixed to the slide to ensure a quick cut-off. This pump is manufactured for boiler feeders, tank feeders, and fire purposes. The crank and flywheel engine and pump is designed to allow of the pump being disconnected and the engine used as a motive power. The crank-pin brasses slide up and down vertical guides formed in the piston-rod crossheads; an old idea revived. This is recommended for all situations where light motive power is required, and especially as a handy pump to have on railroads.

Crerar, Adams & Co., 11–15 *Fifth Avenue, Chicago*, exhibited a McGowan "Buckeye" pump with return connecting-rods similar to the crank and flywheel pump of Cope & Maxwell, p. 125, and which seeemed peculiarly adapted for heavy work.

Chatham, Lewis & Co., 243–5 *Lake St., Chicago*, exhibited a large assortment of hand-pumps for house, yard, garden, fire, and ship purposes, &c.; also hydraulic rams, and rotary and centrifugal pumps all made by the Rumsey Manufacturing Co., Seneca Falls, N. Y.. They also exhibited a Wentworth Water Drawer, which consisted of a galvanized iron bucket with cast-iron bottom in which was a common flap valve. The weight of the bucket would thus always keep it vertical and fill it through the valve when let down into the water. On being drawn up an arrangement at the top tipped and emptied it; the bucket thus required no handling.

Wm. Owen & Son, 59 *Wells Street, Chicago*, exhibited two sizes of that strange looking machine, Hall's Pulsometer. To one who has never seen it, it can best be described by imagining two immense pears joined together at their stems and bottom, and with a smaller pear placed in the cavity between them. To set the apparatus in action it must be completely filled with water. Steam is then introduced through a small ball-valve at the top of one of these pear-shaped chambers (where the stems join), and pressing on the surface, pushes the water within through a large ball-valve at the bottom of the chamber into the discharge pipe. As the chamber is emptied the steam rushes through the same valve, agitating the water before it and thereby condensing itself, producing a good vacuum which draws back the large valve to its seat and the small valve at the top of the chamber, and as the steam is entering the other chamber the one just emptied is being re-filled from the suction pipe by the vacuum within it. We noticed

the stream which it threw was not a very steady one, but as we understand that the large ball-valve was to be removed and valves of another kind substituted, this may be overcome in the new design.

Another apparatus working on the same principle, was the steam Vacuum Pump exhibited by *Nye & Gourlay*, 24 *S. Jefferson St., Chicago.* This apparatus consisted essentially of two 8-inch cylinders, a condenser, an automatic steam, and four "claque" valves, covering the suction and discharge ports. To start the pump the condenser is first filled with water, one of the cylinders is then filled with steam which is suddenly condensed by a jet of water admitted by a pipe from the condenser, forming a vacuum which fills the cylinder with water through the suction pipe. Steam is again turned on into the cylinder, and pressing upon the thin film of air on the surface of the water therein, compresses it and forces on the water, the air entering from the cylinder into the small air-compression cylinder, and the condenser forming air cushions in the top of each. Directly the water cylinder is emptied, the air cushion in the air-compressing cylinder "reacts and forces the rod in "it downward, shutting off steam from the cylinder just "discharged, and letting it into the other water cylinder, "which was being filled with water while the first was be-"ing emptied. At the same moment the air cushion in the "condenser reacts, forcing a jet of water into the steam in "the discharge cylinder, thereby condensing it and forming "a vacuum." The action is then repeated alternately in each cylinder. The larger pump at the Exposition drew water from the lake, 300 feet distant, and 20 ft. 5 in. below the level of the apparatus, the steam guage showing 5 lbs. and the vacuum guage 26 ins. They are in use in this city for keeping dry the works on the Fullerton Ave. sewer, and the new water tunnel under the city, and we understand are giving good satisfaction.

J. B. Erwin, care of G. P. Sherman, 452 *Market Square, Milwaukee, Wis.*, exhibited his "one stroke water drawer." It is a simple arrangement of levers. The apparatus consists of a double set of lattice-bars crossing each other at their centres and pinned together at those points. A system of levers is attached to the upper end of these chain lattice-bars, and the bucket to the lower end; as the upper ends of the two last bars are pulled close together the chain of bars lengthens, as they are pushed apart it shortens, and from the principle of multiplied levers, the crossing point of each pair of bars will be raised or lower just twice as fast as those of the pair above them, so that when the centres of the first pair of bars is raised almost into a horizontal line with their ends, the centres of the lowermost pair will be brought close up to the uppermost, separated only by the thickness of all the bars in the chain placed close together; the height of the lift is limited only of course by the weight of the chain. This is quite an old idea revived.

TURBINES.

There were only two turbines exhibited in the Exposition, out of the large number there are upon the market.

C. A. Gump, 42 & 44 *South Canal Street, Chicago*, exhibited the Eclipse Turbine, in one size. The advantages claimed for this are having the water-gates within the rim, and no bars, levers or racks on the outside, thereby presenting less "fixings" to the action of the water and other outside agencies likely to put them out of order. A slightly higher percentage of useful effect than any other turbine is also claimed, of course; what turbine was ever invented that did not give, at some trial, a higher per centage than its fellows?

The *Blackstone & Elmer Turbine*, manufactured by C. C. Paige, Eagle Iron Works, Oshkosh, Wis., was also exhibited in one size only. Emerson, of Holyoke, Mass.; where all the competitive trials and tests of turbines take place, certifies to a per centage of from .8067 to .8313 on a trial of a 40 in. wheel with whole gate, the results generally showing much uniformity. As there are no bucket partitions in front of the chutes, the wheel is not liable to be choked or broken with any debris which may happen to get into it.

WINDMILLS.

We were again surprised on examining the Agricultural Hall, to find only *two* out of the many varieties of windmills now in use throughout the west.

The *Eclipse Windmill Co., Beloit, Wis.*, represented by J. R. Lawrence, 146 Fifth Avenue, Chicago, was one of the exhibitors. This mill is similar in its general appearance, to that illustrated by us on page 77 *ante*, but differing from it in its governing arrangement. From catalogue it appears that this Company manufactures three classes of mills; (1) for farm pumping, 4 sizes from 8½ ft. to 14 feet diameter, ½ to 2 H. P., and 400 lbs. to 1150 lbs. in weight; (2) for railroad tanks, 5 sizes, from 16 feet to 30 feet diameter; (3) for general motive power, 6 sizes, from 26 ft. to 45 ft. dia., 3 to 22 H. P., and 1800 lbs. to 6000 lbs. weight. No 1 in this class is tabulated as of 25 feet dia., and 8 H. P. Let the reader compare this with the remarks on page 78 *ante*.

The *Challenge Windmill Co., Batavia, Ills.*, exhibited one of their single-headed mills in motion; they also make double-headed windmills for power purposes, the only one, we believe, in the market. The governing apparatus consists of balls hinged to the arm of the sails, and each ball is attached to the head of the sails on each side so as to make the centrifugal force pull the sails out of the wind or allow them to close into the wind. Of the single headed mill, 13 sizes are made; Nos. 1 to 3 fitted with crank-shaft for pumping, of sizes 8 to 12 ft. dia., and power from 1 to 4 man power; No. 4 with crank shaft, size 14 ft. dia., and 1¼ H. P., Nos. 5 to 13 with gearing for power purposes, of sizes from 17½ to 50 feet, and power from 2¼ to 22 H. P. Nos. 8, 25 feet dia., is tabulated as of 5½ H. P. which agrees very fairly with the remarks on 78 of our journal before referred to. The sizes of the two sails of a double-headed windmill seems to have been determined by making each a trifle more than one-half the area of the usual single headed mill of equal power; we should imagine this to be slightly erroneous as one of the sails in the double headed mill being just behind the other, cannot receive the full force of the wind, which is assumed to be 20 to 25 miles per hour in velocity; this plan of stating the velocity assumed for calculation is worthy of imitation by other makers, for by it, intending purchasers can make their own calculations and comparisons with other mills.

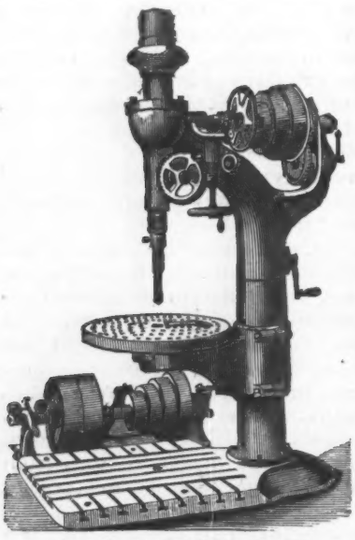
IRONWORKING MACHINERY AND TOOLS.

Some good tools of this class by eastern makers were exhibited, but not as many as we should have liked to see.

Kirkwood & Dunklee, 171-3 *Lake Street, Chicago*, exhibited a well-made 8″ lathe of ordinary pattern, and some sets of pulleys, they are agents for the tools made by the Putnam Machine Co., Fitchburg, Mass., and W. E. Bement & Sons, of Philadelphia, and have in stock all classes of tools needed for Railroad shops and Car Works. Inasmuch however as they did not consider it sufficiently to their interest to furnish illustrations (which they had at hand), and further particulars concerning their exhibits at the Exposition for this article, we are unable to give our readers further particulars concerning the same.

Frank Douglas Machinery Co., 253-5 *South Canal Street, Chicago*, exhibited some good makes of iron lathes and drills, and a slotting machine, all of ordinary type.

Greenlee, Batchelder & Co., 78 & 80 *Lake St. Chicago*, exhibited a lathe and one or two other iron tools, which call for no special remark.



Harrington's 36" Drill.

C. L. Rice & Co., 243-5 *Lake Street*, exhibited some excellent tools by Edwin Harrington & Son, of Philadelphia. One was a 22" lathe which by extension of the bed, can be made, if necessary, to take in 36" work, a carefully designed and well-proportioned tool. Another of their exhibits was the 36" drill which we illustrate herewith by the same makers as the lathe, and of simple form and compact appearance. The steel spindle is 2" dia.; 12" traverse; quick return; geared for 3 changes of self or hand-feed; driven by four speed cone 15" dia. for 3" belt; back gearing giving speeds to spindle; the table revolves on the columns and is raised or lowered by gearing and screw running through a wrought-iron nut, or held in a central position by a pin passing through a bracket into the wrought-iron slide. The general dimensions are, distance from base to spindle 54 ins.; from centre of table to column, 18 ins., and weight of whole machine is 3300 lbs. Messrs. Rice and Co. also keep on stock the tools made by the following eastern makers: Goodell, Braun & Waters, and Richards, Ladin & Kelly, of Philadelphia, the Putnam Machine Co., and P. Blaisdell & Co. They also exhibited a number of Stephens' parallel vises. In these vises, instead of the ordinary square threaded screw, a sliding bar is attached to the moveable jaw of the vise, having a rack on one of its edges. Just behind the fixed jaw is a toggle piece bearing at one end against a toothed bar, or rack, and at the other end as a fulcrum against the back of a fixed vise-jaw. A spring fixed to one end of this toothed bar tends to engage it with the rack on the sliding bar of the moveable jaw, but where the vise is not holding anything, this tendency is restrained by a hook which engages with a catch on the toggle. This hook is attached to a handle working on a pivot alongside the toothed bar and toggle and with a cam-shaped boss. When any article is placed between the jaws of the vise, to be held there, the handle is turned slightly round which releases the toothed bar from the hook on the handle, and allows it to engage immediately with the rack on the sliding bar of the moveable jaw. As the handle is turned around further, its cam-shaped boss pressing against the toothed bar through the medium of the toggle tends to close the moveable jaw against the fixed jaw of the vise with a very great force, as the toggle or elbow-jointed lever is the most powerful mechanical device known. These vises are held in deservedly great favor.

Albert Rice, P. O. Box 296, *Chicago*, exhibited some screw cutting machines, &c., manufactured by Wiley and Russell, Greenfield, Mass. There was Grant's Bolt and Nut Threader, a very neat and simple machine, cutting screw threads on bolts or tapping nuts, and capable of being worked either by hand or power. Grant's adjustable dies were also exhibited; they are now so well known and universally used as scarcely to need description. Grant's friction clutch pulley was also exhibited; in this contrivance curved plates are pressed against the inside of the rims of the pulleys, thereby giving the necessary friction.

Long & Allstatter, Hamilton, Ohio, exhibited four first-class strong and substantial punching and shearing machines; one was a double machine, or punching and shearing machine combined, the other three were machines that could be used for either purpose. They were arranged with fast and loose pulleys to be run by power, and were the only exhibits of the kind in the Exposition.

There was also exhibited a steam striker that could be used for either light or heavy work; this very handy tool attracted as much if not more attention than any other machine in the Exposition; the smith by merely pressing a treadle with his foot could strike either the heaviest or the lightest blows at pleasure; in fact, the machine was as completely under control as a steam hammer, and the mechanism was very simple; we predict a large sale for this tool.

Furst & Bradley, 57–63 *North Desplaines Street*, exhibited three very good machines; the first was a universal boring machine which will be described under the head of wood-working machinery. The second was a drop-hammer weighing 350 lbs. falling from 12 to 30 ins.; the whole machine weighs 450 lbs; the hammer-block slides between standards fixed to the anvil, and is attached to a crank overhead by a leather strap; this crank is fixed on a short shaft, on which also is fixed the driving wheel gearing into a pinion on the driving pulley axle, and a cam wheel with an ordinary catch or "trip" arrangement. It can be operated either by hand or foot, and the leather belt and crank pin adjusted to the proper length for different strokes. It is used chiefly for the manufacture of ploughshares and such-like forgings. The third machine exhibited by this firm was a power press for punching or shearing. Its shearing capacity was 4" × 1" bar-iron, and punching capacity 1¼" hole through 1" iron. Length of stroke 1¾ ins., slide variable up and down ¾ in., depth of throat from centre of punch 14 ins., velocity of fly wheel 150 revs. per min., weight of machine 5,200 lbs. This firm is also a large manufacturer of agricultural machinery.

Fairbank, Morse & Co., as agts. for the St. Johnsbnry Co., Vt., exhibited an elegant case of well finished single and double bevels and squares with adjusting screws, and several handy novelties in their make; the tools were so well finished and workmanlike in appearance that one longed to take some out of the case, and "see how they worked."

WOOD-WORKING MACHINERY AND TOOLS.

This class of machinery was very well represented at the Exposition; this is in consequence of Chicago being one of the great centres of the lumber trade, and Michigan, Illinois, and Wisconsin great States for its manufacture.

Triumph Planing Machine Co., 90 *Washington Street, Chicago*, exhibited one of their planers and matchers. They are made to use three sizes, 8", 12" and 14" work respectively, and to plane thicknesses of ⅜" to 2". Their machine was plain, but strong and durable in appearance, and simple in gear. The planer head admits six knives which revolve within a circle of 6½ ins., being less than the ordinary 3-wing cutter head. The machine is also fitted with an improved matcher head in which the knives are clamped between discs which bring them to the same seats vertically, consequently little time is lost in their adjustment.

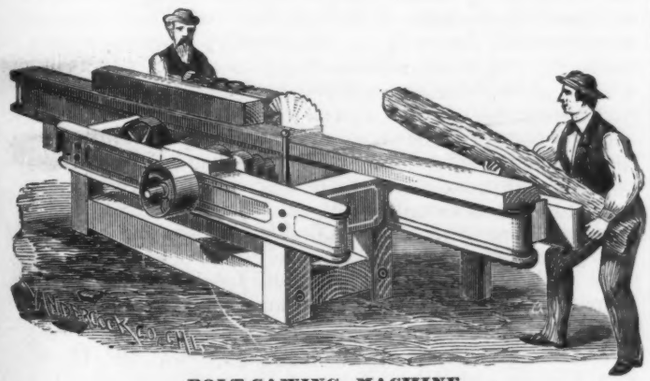
Williams, White & Co., Moline, Ills., exhibited a very simple skein-setter and lathe for turning irregular forms, and a new shaft coupler in which the two shaft-ends are brought together and held by an arrangement of wedges. In the lathe the cutter is fixed on one end of a curved bar, which is supported on an axis about its centre, and revolves transversely to its length; this axis is by suitable gearing given a fast motion, and at the other end of this bar,

holding a tracer, is made to bear upon, and travel over every point of the skein, so that all curves, &c., on the skein are faithfully cut out on the wagon axle fixed under the cutter at the other end of the bar. This is an ingenious and well-designed machine; it is stated by the manufacturers that a good workman can, with the power machine, bore the holes, fit the skein, and put in the skein bolts for 25 to 40 wagons, in a day of 10 hours.

Battle Creek Machinery Co., Battle Creek, Mich., exhibited that elegant machine, Boult's Carver and Moulder which is already so favorably known throughout the country. It is capable of doing all kinds of carving, moulding, panelling, and dove-tailing either of straight, circular, oval or other curved forms. One specially good point about it, is that it has a reverse motion in all its applications, so that the cutting can always be done with the grain of the wood, and an amount of finish put on, limited only by the sharpness of the cutters. All work is thus turned out from the machine ready for immediate use.

W. F. Moody, 181 *South Jefferson Street, Chicago*, exhibited an ingenious dove-tailing machine in which any number of dove-tails could be cut at once. This machine when it was working attracted as much attention as Boult's machine, just described, which was turning out its picture frames with sunk or raised mouldings, by the dozen.

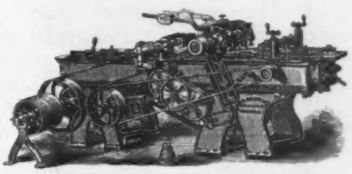
Kirkwood & Dunklee, 171-3 *Lake Street*, exhibited a large assortment of wood working machinery, including a surfacer, planer and matcher, hand saws, re-saws, and scroll-saws. Also an emery saw-gumming machine, Sturtevant blowers and exhaust fans. As regards the illustration of these various machines, the same remarks apply as we made on page 127 regarding their exhibits of iron machines and tools.



BOLT-SAWING MACHINE.

Smith & Montross, Wolverine Handle Factory, Galien, Mich., exhibited the Bolt-Sawing Machine which we illustrate above. The action was very smooth, and arrangement of gearing compact and simple. It was arranged to be worked by hand (through the hand lever shown,) or by power on the belt pulley shown. A good guarantee of its excellence is the fact of the machine at the Exposition being sold at sight to the great Mower and Reaper Mauufacturers of this city, the McCormicks. The largest wheel shown in the cut and its axis is capable of a slight movement in the direction of the length of the machine, this movement being given by a lever and cam on a spindle which runs across the machine and is under the immediate control of the attendant. By moving the wheel *backwards* about 2 inches, it is bronght into contact with a pulley on a cross-bar carrying speed cones, these speed cones are connected with another set on the driving pulley shaft (which also carries the saw), by the usual leather belt. This driving shaft also carries a pulley which is in constant contact with another pulley intermediate between it and the large feed wheel. By moving the large wheel *forward* from its normal position, it is bronght into contact with this intermediate pulley. These forward or backward movements give the feed to the machine through the medium of a rack, and a pinion on the same axis as the large feed wheel. This machine can take saws with 2″ arbors and 50″ dia.; for the business of the inventor and manufacturer 36″ is the usual size of saws employed. A few notes regarding this business which represents one of the the staple industries of Michigan, may be of interest. The Wolverine Handle Factory turned out last year over 1,000,000 fork and shovel handles, 2,000,000 broom handles, 2,500 dozen cradle fingers, and 1,060 dozen barley forks; $10,000 worth of D-shovel handles were sent to Germany alone. Ames' bend, shovel, spade, and scoop handles, hoe, rake, and broom handles, cradle fingers, and Excelsior grain and barley forks, are all manufactured by this firm. Returning to the machine illustrated, we may state that its invention arose from the pressing need felt by the inventors themselves for such a machine to use in their handle factory, and not with the intention of bringing it into market until an increasing demand for the machine obliged them to do so this year. This machine can saw from 15,000 to 20,000 ft. B. M., per diem, of logs 16″ dia., or if used for sawing out handles, can keep four ash lathes supplied, or six lathes turning broom handles and requires from 5 to 8 H. P. A 10 H.P. engine furnishes sufficient power to run one of those machines and four lathes at the same time.

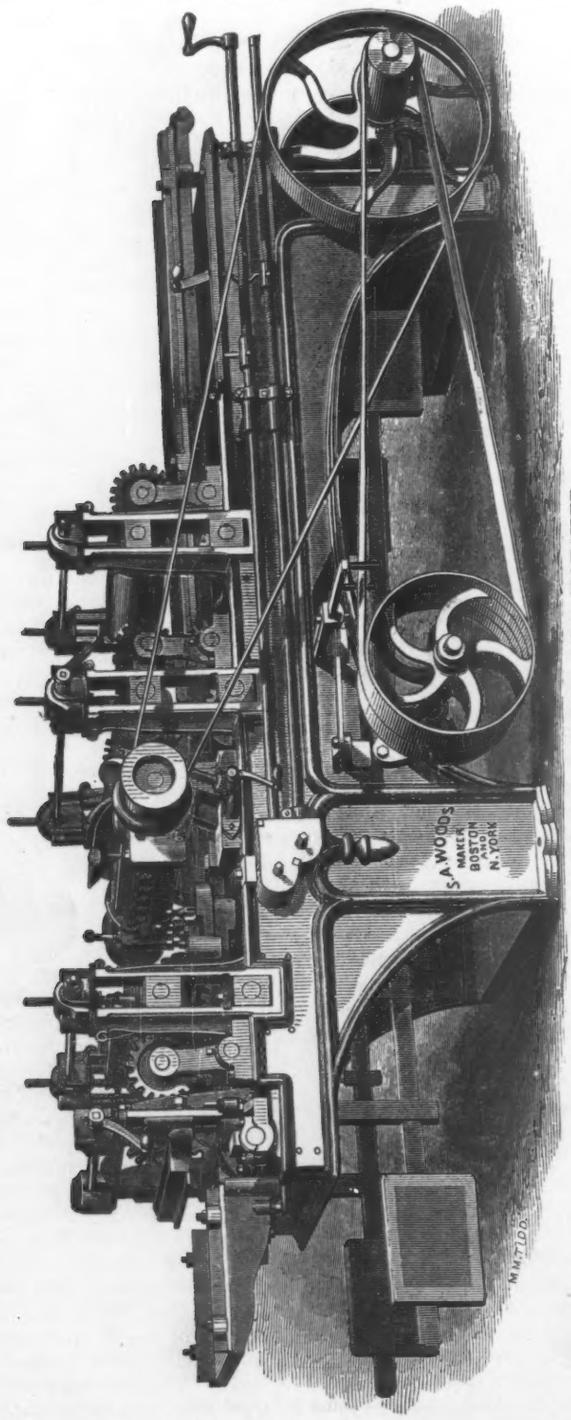
C. L. Rice & Co., 215–7 *Lake St*, exhibited a mortiser, a moulding machine, a planer and matcher, and hand-saws at work, making puzzles for the ingenious, and cutting out miniature chairs all in one piece. They also exhibited Sturtevant Blowers, and keep in stock all classes of wood-working machines. The band-saws exhibited had frames well designed to resist springing; the wheels were 36 inches dia., with wrought-iron spokes and rubber covered wooden rim; they stood 8 ft. 3 ins. high, occupied nine square feet of flooring, and weighed 600 lbs. Their scroll-saws were simplicity itself, and worked very well.



C. B. Rogers & Co.'s Moulder.

Frank Douglas Machinery Co., 253-5 *South Canal Street, Chicago*, exclusive agents for J. H. Fay, Cincinnati, and C. B. Rogers, of Norwich, Conn., exhibited a very fine moulding machine with outside heads, and several other woodworking machines. We illustrate herewith the No. 1 Moulder with inside heads, manufactured by the well-known firm of C. B. Rogers & Co., Norwich, Conn. This machine will take in a moulding to be worked 12 ins. wide on four sides, and 5 ins. thick. The bed is made in sections for convenience of arranging the cutters. There are five speeds provided, giving from 15 to 40 feet per min. It is well provided with pressure-bars, springs, guides, &c., and can be used equally well either as planer and matcher or as moulding machine.

Furst & Bradley, 57-63 *North Desplaines Street, Chicago*, exhibited a well-designed multiple boring machine. It had six spindles carrying 12 auger bits; two bits geared together on each spindle; these bits are always on a line with the bed of the machine, and adjustable laterally to within four inches of the centre. The two bits on each head ran in opposite directions, but the gearing was changeable at the back end of the spindle, allowing them to be run either way. The machine was capable of boring in one operation, anywhere within an area of 6 ft. × 6 ins.; size of driving pulley, 16 ins. dia.



S. A. WOODS' PLANER AND MATCHER.

Greenlee Bachelder & Co., 80 Lake Street, Chicago, exhibited the fine machine which we illustrate herewith. It is a No. 6 planer and matcher, 11 feet long, with 6 feed rolls, 6 ins. dia., and weighs 5,250 lbs., manufactured by the S. A. Woods Machine Co., Boston, Mass., for which firm Messrs Greenlee, Batchelder and Co., are the exclusive western agents. We are sorry that we haven't space to give a full description of this fine machine, which for beauty of finish and workmanlike appearance was unsurpassed by any in the Exposition. Among the improvements made in this machine, are joining the top cutter boxes together by a yoke *underneath* the bed of the machine, placing the under cutter head near the end of the machine which arrangements enable the cutters to be easily got at to be set or sharpened; a pressure-bar in front of the surface cutters, to prevent the lumber splitting when cross-grained; a chip-breaker on the same principle attached to the side cutter heads, and gearing both ends of the feed rolls in the expansion gearing are other improvements that will be noticed. This machine is manufactured in 10 sizes with 4, 6, and 8 feed rolls giving a variety of 36 different constructions, the machine weighing from 3,500 to 12,000 lbs. They also exhibited self-oiling circular saw arbors, with a cone-bushing, enabling various sized saws to be used on the same arbor. They also keep on hand iron lathes, drills, and shaping machines.

Emerson & Co., Rockford, Ills., exhibited West's tire-setting machine, by which a tire could be set round a wheel, tightened up, or "upset" *cold*, and the wheel "dished" to any extent desired. The machine consists chiefly of a wrought-iron band which surrounds the wheel and tire to be tightened up and which are supported on rests; the ends of this band are attached to a block which is tapped and threaded, and through which a screw works; when this screw is set in motion it presses against a wedge between two layers of the band. This very useful machine is a great improvement on the old method of setting tires hot, thereby burning the felloes.

Culver & Foster, 17 N. Jefferson St., Chicago, exhibited Beard's box-nailing machine, which attracted a great amount of attention. The pieces to be nailed together are put upon a table, under which is a vertical rack gearing into a pinion driven by a wheel which gears into a pinion on the driving pulley shaft. Above the table are a series of punches ranged either in single or double rows, and as close as desired, under which is a box into which the nails are fed by an automatic arrangement, and the nails are driven through holes in the bottom of the box. Three sizes are manufactured; No. 1 of 50″ × 50″ capacity; No. 2 takes boxes measuring 2 to 35 ins. square; and No. 3 takes 2 to 25 ins. square. This firm also manufactures a blocking machine for dressing the edges of boxes.

G. H. Gove, Rockford, Ills., exhibited a clever little mechanical dodge, of which he sold no less than 80 in one week, at the Exposition. It was a double-spring mitre box for sawing mitres or bevels of any desired angle.

Henry Disston & Sons, Philadelphia, and Randolph St. Chicago, exhibited a very effectively arranged assortment of all kinds of saws, bevels, squares, levels, files, trowels, wood and wire guages, &c., and tools for sharpening and setting teeth of saws.

RAILROAD SUPPLIES.

Crerar, Adams & Co., 11 and 13 Fifth Ave., Chicago, were almost the only exhibitors in this special department, and had an elegant case of every description of railroad lamps and fixings for cars, locomotive head-lights, &c. They also had a stand of strong and serviceable trucks for baggage and express purposes, and a strong and well-balanced hand-car. Another exhibit which we believe they are about to manufacture for the market, was the automatic distance signal lamps. This is an arrangement of two lamps connected together by a tube about 5 ft. long. In one lamp is a light burner and a plain "bull's-eye" in the other a plate-glass reflector placed at an angle of 45°, and a red "bull's-eye" lens. This apparatus is fixed at the rear end of a train, and by the apparent distance between the lights, the engineer of a train behind can judge his distance therefrom. This firm also exhibited some good samples of tyres and axles for railroad cars.

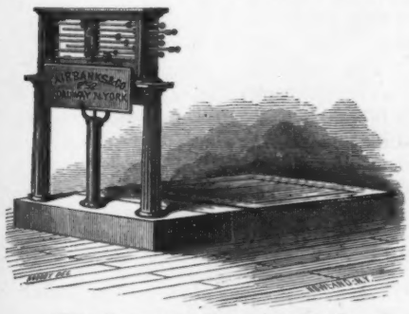
Chicago Car Wheel Co., cor. 15th and Dearborn Sts., exhibited some excellent samples of their steel tired car wheels which are largely used on our westeru roads.

H. Disney exhibited his patented automatic car-coupler, which is also on exhibition at Canda's offices, 79 Clark

Street, Chicago. It is a simple and durable arrangement and already in use on Railroads in California and Nevada, and on the Cairo and St. Louis, and Chicago, Danville & Vincennes Road.

Chicago Portable Car & Track Co., 57 *Dearborn St.*, exhibited some of their cars and track in the Gallery. These trucks or cars are side-tipping instead of end-tipping, and the sections of rail are merely jointed together by a simple hook and stud. These cars are being extensively used in New Orleans, around this City and in the Mining States and Territories; they are very handy for contractors' uses.

WEIGHING SCALES.

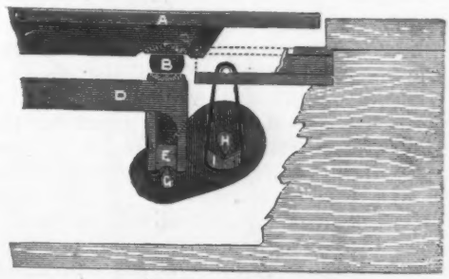


The Furnace Charging Scale.

Fairbank, Morse & Co., 111 *Lake Street, Chicago*, had three stands of scales at the Exposition, fitted up with elegant samples of their various manufactures in scales of all descriptions, and coffee grinding mills for grocers' stores. Among the scales exhibited were several novelties; there was the Miners and Transportation Scale, with 14 scales in one, a Grain Hopper scale in which the amounts in *pecks* and *bushels* of wheat, corn, barley, and oats were given on five scales, a General Produce Beam, a Railroad track-scale which can weigh 200 tons, and is 200 feet in length, tested after 6,000,000 tons had been weighed upon it, showing only some two or three hundredths of a ton of difference from when new; the Furnace charging scale which we illustrate herewith, was also a well-designed novelty. In the cut the scale box is shown open, with six scales in it, used for ore, fuel, and flux. The furnace superintendent fixes the studs or the bars according to the different proportions of ore, flux and fuel which he wishes to use, then locks up the box, and the weigher in weighing each ingredient of the furnace charge, pulls out the proper bar for it until stopped by the stud. A very simple and highly useful invention greatly appreciated by iron-masters. In one of their stands were a number of scales graduated with the weights of different nations; this firm manufactures largely for foreign countries, they gained the first prizes at the Paris Exposition of 1867, against 34 competitors, and at Vienna, last year, against "all the world."

A. M Gilbert & Co., 38 *State Street, Chicago*, exhibited a fine stand of Howe's Scales, manufactured by the Brandon Manufacturing Company. This scale has recently gained the first prize at the Mechanics' Institute Fair in San Francisco, 3rd inst. All kinds of dormant and counter scales were exhibited by this firm, and the chief points in the construction of the Howe Scales will be understood by the accompanying engraving of a dormant scale. In the old style of scale,

Howe's Dormant Scale.



Corner Section.

there are 19 knife edges, in the Howe's, 14, so that the friction in the latter is less than the former. The platform A in the corner section is supported on chilled-iron balls B, and adjustable bearings E; these relieve the knife edges G, H, of all friction from any sudden shock on the platform. These scales are rapidly making their way in public favor.

BUILDING MATERIALS AND APPLIANCES.

Of these there were not very many exhibits.

Chas. C. Colson, 180 *Canal Street*, exhibited samples of firebrick and a retort manufactured by the Laclede Fire Brick Co. The bricks were moulded for use as blast furnace linings, and had a good even texture and very fine grain, almost too fine for furnace hearths.

Huntoon & Christian, Evanston, Ills., exhibited some good samples both of common brick and Philadelphia pressed brick made at their yards.

John Cooper, Manufacturing Co., Mt. Vernon, O., exhibited samples of Holmes' wrought-iron furring and lathing which is offered as a fire-proof substitute of wooden lathing, and one which gives better *bond* for the plastering.

Standard Shutter Co., 78 *Monroe St., Chicago*, exhibited the wrought-iron shutters which are now applied to fire-proof buildings, also Gilbert's patent fire-proof ceiling, which is simply ordinary wrought-iron floor beams with corrugated iron arches between them.

Chicago Cement Pipe Co., 110 *LaSalle St.*, exhibited a number of samples of round and egg-shaped sewer pipes, dried by their process of "carbonizing" by steam and gases in an air-tight furnace. The later samples shewed a very close texture and smooth surface, and appeared well qualified for sewerage purposes. We shall watch the proceedings of this Company with much interest in view of the prejudice that still exists in many quarters against the use of cement sewer pipes; especially, as we believe they are giving careful and faithful attention to securing a uniformly good quality in their manufacture.

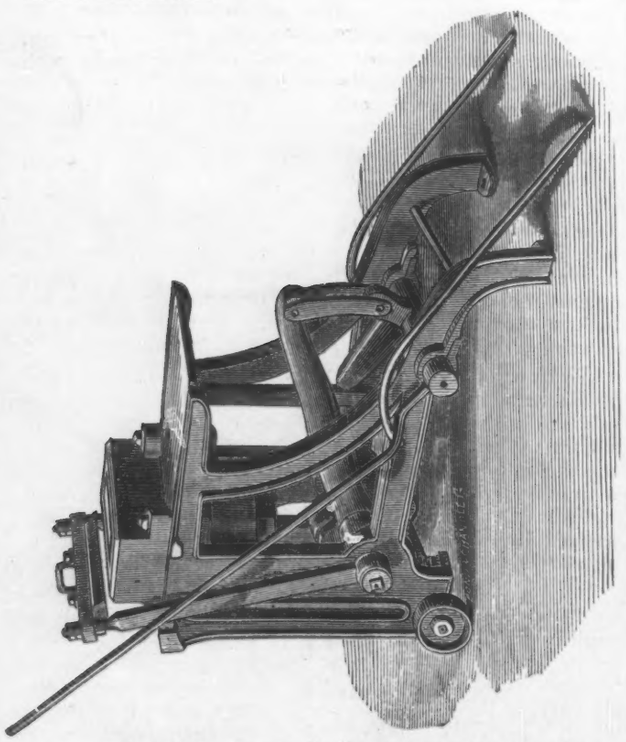
N. M. & L. R. Miller, 47 *Third Ave., Chicago*, exhibited some circular wooden eave-troughs which possess considerable advantages in some respects over the usual tin troughs; it will not burst by frost, being made of well-seasoned lumber; all joints and connections are easily made with galvanized-iron connections. The troughs are about 5/8 inches thick, and are joined together by strips of galvanized iron inserted with slits sawn in the ends of the pieces to be joined together.

Oxygenated Paint and Oil Co., 13 *South Canal St.*, exhibited samples of their paints, oils, and cement in its application to roofs. The principle ingredients in these paints are the silicate of alumina, and silica itself, in combination with lead, zinc, or other of the metallic elements. By varying these proportions, an elastic glass is obtained which is perfectly impervious to atmospheric influence, or to water. The cement paint is used principally for coating roofs of iron, tin, or wood, stopping leaks, or laying slate roofs on a new principle which renders them perfectly water-tight and prevents any accumulation of moisture

liable to be absorbed by the pores of the slates, to be converted into steam and burst the slate in case of fire, or into ice with the same effect in case of hard frost; the slates are so so laid as that all the joints are lap-joints, and only 130 are required to cover a "square" as against 257 of the old method; the roof will also be much lighter, weighing 325 lbs. per square as against 900 lbs. in the tar and gravel roofs, in which the gravel weighs 110 lbs. per cubic foot. The cement paint is also an equally good preservative coating to iron and other metals, wears well and has a good appearance.

J. C. Schweizer, at Kramer Bros., 264-6 Madison St., Chicago, exhibited a model of an arrangement of tanks prepared with holes to be placed in rooms for use in case of conflagration, the principle of which reminds us forcibly of the decision arrived at by the celebrated congress of rats and mice, and the resolution passed that a bell should be hung round the neck of the obnoxious cat; an excellent plan if *practicable*, but unfortunately no one could be found who would carry it out. So with Mr. Schweizer's tank arrangements; who will be found to rush into the room where a conflagration is in progress to turn on the tap of the tank?

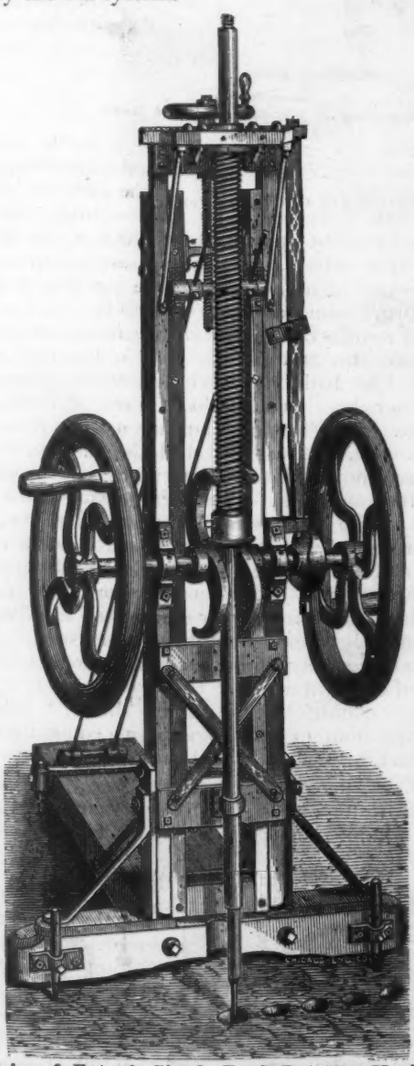
H. Lissberger & Co., Garden City Lead Pipe Works, cor. South Clinton and Jackson Sts., had a tastefully arranged stand of various of various sizes of their tin-encased lead-pipe, also blocks of Babbitt metal, copper, tin, and other metals. As the lead pipe is pressed out of the pipe-making press it passes through a bath of molten tin which adheres to both inside and outside surfaces, coating it completely, and rendering it equally innocuous for supplying water either from wells or mains. This is a very useful invention, and as the price for this kind of pipe is only one cent per lb. more than ordinary lead pipe, it ought to come into extensive use, as cases of lead poisoning are by no means uncommon.



F. C. Wells & Co.'s Brick Pressing Machine.

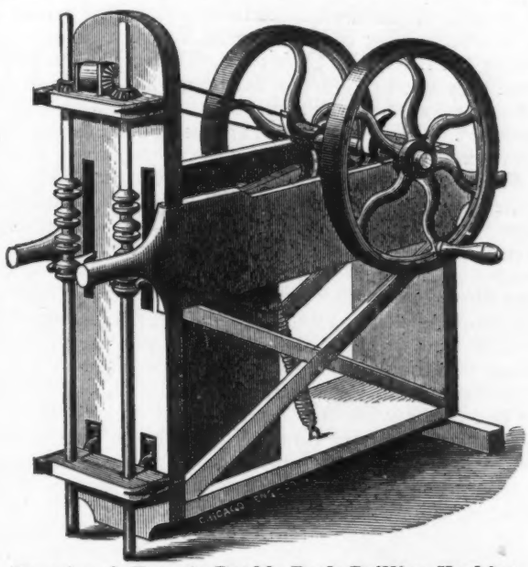
F. C. Wells & Co., 116–22 *South Clinton St.*, exhibited the brick pressing machine which we illustrate herewith. It is an improvement on the ordinary Philadelphia press in having only one lever to move instead of two to perform the operation. We understand there is a large demand for these, and that they are to a considerable extent superseding the Philadelphia presses. They also exhibited some good substantial brickmakers' barrows and trucks.

Chase & Co., Peoria, Ills., exhibited a well constructed model of their system of elevating, conveying, storing and shipping grain. In this system the bins are made 16 feet square, of 1 inch boards nailed to studding, and built on the ground, 16 ft. or more in height. The grain is elevated to the height of 25 ft., in the usual manner, weighed in hopper scales, distributed to the bins by horizontal conveyors placed over the top of the bins, and brought back to the foot of the elevator by conveyors placed below the bins. About 50 elevators have been built on this system, at a cost of ⅓ of the amount they would have cost for the same capacity by the old system.



Downing & Eaton's Single Rock Drilling Machine.

Collins Eaton 70 *South Clinton St.*, exhibited Downing & Eaton's single and double rock drilling machines, both of which we illustrate. The single machine can be adjusted by means of the two light back stays shown, and set-screws, to drill vertical inclined or horizontal holes. The percussive action of the drill is given by the the two cam-shaped arms on the driving shaft, and the drill is at



Downing & Eaton's Double Rock-Drilling Machine.

the same time turned party around on its axis by an arm attached to a vertical lever actuated as shown by the cam on the driving shaft close to the hand wheel on the left-hand side of the drawing. The double machine can be driven either by one man for a few hours or two men all day. The drill is a *square* bar passing through a tube, on which is fixed a bevel wheel on top, and the lifting studs or collars lower down. The drill is lifted by levers acting on these collars, which levers are moved by the cam-shaped arms on the driving shaft, as in the case of the single drill. The drills are given a continuous rotary motion by bevel wheels driven by belt from the driving shaft. By slight modifications in detail, we see how these drills (in the double machine) can be made to work at any angle with the ground surface and *with each other*. Both machines are portable, cheap and useful machines, and are destined, we should think, to come into extensive use, especially in our mining States and Territories. This exhibitor also showed one of Forth's iron clamp French burr stones, in which the spindle is horizontal and has an arrangement whereby the stones can be adjusted with any amount of space between, either when still or running. The stones are well hung, and have long journals.

CAST AND WROUGHT IRON AND STEEL.

Under this head we have grouped such exhibits of the reduction of iron from the ore into serviceable form, or the manufacture into simple articles, such as bolts, valves, etc., as seemed to us most noteworthy.

North Chicago Rolling Mills exhibits were in many respects one of the most important stands in the Exposition. These works, which were established in 1857 and incorporated in 1869 as a joint stock company, with $3,000,000 of capital, are among the most successful steel works in the country. They employ 1,500 men, and their annual capacity is 30,000 tons of iron rails, 36,000 tons of steel rails, and 50,000 tons of pig iron. As we hope at some future day to give a full description of these works to our readers, we will now only treat of them generally. The opportunity must not be lost, however, of stating that on September 28 the Bessemer steel department made 52 heats out of the two 5-ton converters, while the Troy works, running a race with them, at the same time turned out 50 heats. During the week ending August 15, they turned out the longest run on record, viz., 196 heats, producing 1,024 tons (*long*) 2,116 lbs of steel ingots, each 12 inches long, and rolled into two rails. The whole of the steel plant is of the latest and most improved description, hydraulic power being used for every operation except in the blowing and rolling mill engines, which of course are driven by steam. The ores used in these works are magnetic and specular from Lake Superior, and limonite or brown hematite, from Missouri. At the Exposition they exhibited a pile some five feet high of "chunks" of Lake Superior specular ore; also a pile of Bessemer pig about five feet high, *i. e.*, manganiferous and silicious pig iron, specially made for conversion into steel in the converters. Samples of "spiegeleisen" from Germany, were shown; we understand that the company rarely use the "Franklinite" pig, of New Jersey. The ingots exhibited showed fine clean surfaces, and where cut through perfect homogeneity of structure. Two polished samples of 60-lb Bessemer rails, twisted, were exhibited; the one twisted completely round in a length of 13½ inches, or about 2½ times its depth; the other twisted once around in a length of about 23½ inches. There were, besides these two, eight other samples of twisted steel rails; samples of steel rails rolled for the Baltimore, Pittsburg & Chicago, Milwaukee & St. Paul, Chicago & Northwestern, and Illinois Central Railroads, weighing 64 lbs. (iron), 58 lbs., 60 lbs., and 60 lbs., respectively, were also shown. The lightest section rolled was a 40-lbs. tram road, and the heaviest a 72-lbs. railroad section. From Feb. 9 to Sept. 26 inclusively the production of the steel department amounted to 24,150 tons of ingots.

Chicago Steel Works, 489 *Noble Street*, exhibited some very good samples of tires, harrow and threshing machine teeth, sleigh shoes, plow beams, etc., manufactured out of Bessemer steel. Works at Buffalo pits made, last year, 15 tons of harrow teeth, of steel, which lasted three times as long as iron teeth. The Bessemer metal possesses great toughness and homogeneousness, which peculiarly fits it for use in the manufacture of agricultual implements; and this company deserves credit for having successfully established their manufacture, contending, thereby, against the many prejudices of the ignorant. Their chief specialty is the manufacture of the wrought cast-steel plow-beams before alluded to as being made of Bessemer steel. These are very well proportioned, and designed with an evident view to securing strength, stiffness, and lightness; and, as their cost is but slightly greater than that of heavy iron beams, while the relative strengths are in the proportion of 90 to 49, these steel beams are, without doubt, destined to supersede the old iron ones. These exhibits attracted much attention from visitors.

Cregier, Clark & Co., Continental Bolt Man'f'g Co., Chicago, exhibited a fine assortment of all descriptions of bolts which are made at these works; also a working model of their water-gate, and a full-sized hydrant on D. C. Cregier's patent; both of these latter exhibits require special mention. The water-gate, which is designed for mains 24" dia. and upwards, has a small supplemental gate or valve fitted on the lower portion of the main valve; this supplemental valve has the usual nut in which the raising screw works. As this valve is raised, and the pressure against the main gate is thereby relieved, it comes up against a stop on the main gate, and, as the raising-screw continues turning, the main gate is thus raised. This is a simple and effective method of relieving the pressure on a large water-gate when it is to be raised. They are manufactured up to 48 ins. dia. The fire-hydrant is in almost exclusive use in this city, and is likely to be largely used throughout the country, as its merits become known; it has been in use for 13 years, and thus thoroughly well tested. At the bottom of the hydrant, where it connects with the water-main, is a supplemental valve of the ordinary conical form, but inverted. This is *in addition* to

the ordinary main stop-valve. When it is desired to remove the hydrant for repairs, etc., the cap is first taken off, when access is gained to a "union" on the valve-stem, by turning which the conical supplemental valve at the bottom is raised to its seat, and the whole hydrant may then be removed without interfering with the main. An arrangement is also provided whereby the hydrants can be made as drinking fountains. We hope soon to illustrate these hydrants, and then give a more extended notice of them.

Columbia Iron Foundry, 32–6 *Front Street, Chicago*, exhibited some good, clean and sound-looking castings, including two engine-cylinders, one about 15″×36″, a screw-propeller, two car-wheels, geared wheels, and other millwright work, etc.

Illinois Iron and Bolt Co., Carpentersville, Ill., exhibited a large assortment of smith's tools and appliances, wagon skeins, seat springs, jack screws, copying presses, etc., etc.; and, among the rest, the Marsh twyer irons. This is a twyer fitted with a valve whereby the strength of the blast may be regulated at pleasure. We see nothing new in this idea; the form of the twyer is a novelty, but we see no particular advantage in it.

W. W. Allmand, 189 *Michigan Avenue, Chicago*, exhibited a very neat and simple little machine for boring out and refitting globe and stop valves. It is a small lathe in which the circular cutter is fixed at one end, driven in the ordinary way, by a belt running on speed cones, and a conical cup rest is arranged on the other end to hold the valve while being bored.

Redfield, Bowen & Co., 112–6 *Lake Street*, exhibited some excellent samples of butt and lap-welded wrought-iron pipes, from ⅛″ to 8″ dia., boiler plates and ends, showing fine clean surface and uniformly good quality; zinc plates, and multitubular heating apparatus, which are so frequently used for heating offices and hotels. They also exhibited steam-fittings of all kinds for boilers.

These exhibits were mostly the make of the National Tube Works of McKeesport, Pa., and Boston, Mass. The works at McKeesport cover six acres of ground, and employ, when in full operation, 800 hands. Those at Boston employ 450 men, and cover about three acres of land. American charcoal iron is chiefly used in their wrought-iron pipe and boiler tubes, which are made from ⅛″ to 16″ dia., and larger if desired. A coupling which they manufacture for wrought-iron pipe, which was exhibited, is also an improvement on those in general use. The business of these works is rapidly increasing.

Walworth, Brooks & Co., 243–5 *Lake St, Chicago*, exhibited wrought-iron pipe, both lap and butt-welded from 1-16″ to 10″ dia., Newport's patent water-gates, globe valves from ⅜″ to 12″ dia., the valves being loose on the spindle, steam traps, peat valves, and fittings for boilers of all kinds. They also exhibited Mason's pipe-radiator for offices.

Crane Bros. Manufacturing Co., 10 *N. Jefferson St. Chicago*, also exhibited some samples of wrought-iron pipe and steam warming and ventilating apparatus.

C. E. Roberts & Co., 7 *and* 9 *S. Jefferson St., Chicago*, manufacturers of all description of screws, exhibited a machine by which many of their manufactures were made. It was a very neat and cleverly designed lathe with a horizontal chuck on one end, which could hold as many as 10 tools at once. We saw a piece of ¼″ brass wire put into the lathe, a portion cut off, then turned on the outside, then bored, then tapped, then reversed in the chuck, and the other end turned and milled on the edge, and a small brass nut with milled head, for use in some parts of a sewing machine was then turned out—the work of a few seconds.

Kirk and Barker, 196–8 *Lake St., Chicago*, exhibited a very tastefully arranged and complete assortment of carriage-makers' hardware, including the Bridgeport Co.'s springs and axles; Solar Hoop Mill's manufactures (Pittsburg); J. M. King & Co.'s tools, (Waterford, N. Y.); also some very good samples of merchant bar-iron bent double without a fracture, and some bars cut through and then fractured. These samples all showed good even color, uniform texture and long fibre.

Kimbark Bros. & Co., 88 *Michigan Ave., Chicago*, exhibited all kinds of hardware, steel springs, Norway carriage goods, &c., and among the rest samples of chrome steel in bars and tools, for which they are the sole western agents. This steel is the best and most reliable we now have for tools in which great hardness is a requisite.

Cope & Maxwell, 24–6 *S. Canal St., Chicago*, exhibited some of Ludlow's and Brown's patent water gates and valves. In the Ludlow valve the valves are brought tight up to their faces by wedges. In the smaller steam valve, one face of the valve is inclined so that the whole valve is thus of wedged-shape form. In the large iron valves, or water gates, two wedges are fixed on the sides of the valve casing, and as the valve is screwed down it comes against these wedges, which entering betweer cheeks on the rims of the two valve faces, thus forces them asunder and gives a water-tight joint.

ORES AND OTHER MINERALS.

In this Section we consider the exhibition was by no means what it ought to have been. Not a single specimen of Illinois coal was to be found through the Exposition, nor its lead, iron or copper. "Why was this thusly?" We look for and strongly urge great improvement in this respect in next year's Exposition.

J. L. Reed, 603 *Larabee St., Chicago*, exhibited, as agent for B. Shepherd, specimens of various silver bearing ores from Utah. Argentiferous galena, pyritic ores, chlorides, black oxides, and molybdenites were chiefly the class of exhibits; the last class is a new one in the market.

North Chicago Rolling Mills Co.'s exhibition of Lake Superior specular ores has already been referred to under our last division.

Atchison, Topeka, and Santa Fee R. R. Co., 77 *Clark St., Chicago*, exhibited various fine blocks of building stone (magnesian limestone and sandstone) from their lands in Kansas, both of good close texture and uniform color. They also exhibited ochre from a vein 20 ft. thick, magnetite from Canyon City, Colorado, and some bituminous coal from Grenada, on the Arkansas River, Colorado, the present terminus of their railroad.

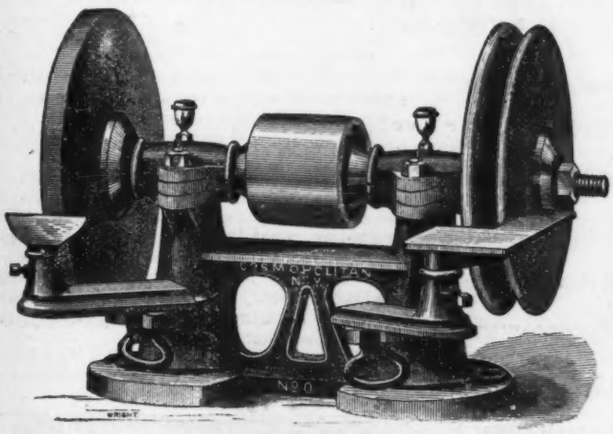
Union Pacific R. R. Co., 57 *Clark St., Chicago*, exhibited the most important collection of minerals in the Exposition. There was gold quartz from Utah and Wyoming, the former showing *free* gold; copper ores from Utah, and lead and silver ores from Utah, including argentiferous galenas and silver chlorides. Specimens from the Lone Star district assayed silver 30 oz. and copper 70 per cent. Tidal Wave mine assayed $350 of silver to the ton. There was silver ore also from the much talked of Black Hills; hœmatite from Rawlins, and magnetite (a very fine sample) from the Laramie Hills, Wyoming Territory; bituminous coal from a 32 ft. vein at Rock Springs, Wyoming Terr.; petrified shells in shale, and fossil fish from Green River, Wyoming.

Space will not allow us to go into fuller particulars concerning this exhibit which was both instructive and interesting.

MISCELLANEOUS EXHIBITS.

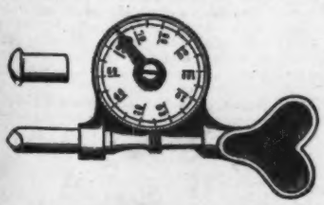
Enos Brown & Co., 19 *and* 21 *Randolph Street*, exhibited five machines connected with the manufacture of woolen cloths. One was a reed-making machine which made reeds for use in weaving carpet and cassimere on hand or power looms; two other machines were for shear-

ing off the loose ends on the surface of fine cloths; one was made with an iron frame, the other with a wooden frame; a fourth machine was one registering the length of a woven fabric, and cutting it off in right lengths. They also exhibited a very ingenious machine for making carding cloth, manufactured by Stedman & Fuller, of Lawrence, Mess. It performed all the operations of drawing in the wire, cutting it to the right length, bending it double, punching the holes in the leather band or "card cloth," driving the bent wire through the holes, and bending the points over. It was making cloth 3″ wide, and putting in 96 rows of teeth in that width; 800 of these teeth were being set per minute. This very interesting little machine, no larger than a sewing machine, attracted universal attention; there was always an admiring crowd around it.



NO. 0, COSMOPOLITAN EMERY GRINDER.

J. D. Huntington, 42–4 *South Canal Street*, exhibited a fine assortment of emery wheels of all sizes from 1″ to 36″ dia. The chief features of these wheels are their utter imperviousness to moisture, and the possibility of handling them very shortly after they are manufactured. They are are made of emery, oxy-chloride of zinc and tin, and carbonate of baryta; this composition giving a very firm cement. We illustrate the No. 0, Cosmopolitan Grinder, which has 1 5/8″ steel arbor for wheels, with 3/4″ mandrel hole, and will run two wheels 12″ dia. up to 2″ face. The speed indicator which we illustrate herewith should be in the possession of every engineer, mechanic, and owner of machines; it is exceedingly handy and useful, and is provided with a thimble to cover the point so that it can be put into the vest-pocket. The point of the indicator is ground with three faces, so as to give a firm hold when placed in the end of any revolving shaft. The dial is turned once for every hundred revolutions of the indicator spindle, by the worm on the spindle, as shown; the pointer is thus stationary, while the dial revolves.



SPEED INDICATOR.

Babcock Manuf'g Co., 325–31 *S. Desplaines St.*, exhibited one of their self-acting fire engines, in which both the working and extinguishing agent is carbonic acid gas, or "carbonic anhydride," as it is now called. It was handsomely painted and doubtless as serviceable as the many others of the same manufacture which are now so universally employed.

E. P. Peacock, 143 *S. Clinton St.*, exhibited an elegant little case of all kinds of light metal work, chiefly fittings for sewing machines, which were all well finished.

J. Ellinson, 280 *W. Indiana St.*, exhibited a working model of a guard gate for drawbridges, in which the open- of the bridge raised the gate into position, closing the roadway. It was a simple contrivance and appeared not very likely to get out of order.

H. H. Evarts, 132 *La Salle St.*, exhibited the hydraulic elevator which was in constant use at the north end of the building. In this elevator the car was fixed on the top of a long piston or ram which fits loosely in a cylinder which is sunk in the ground to a depth equal to the height of the proposed lift. Water under pressure is admitted into this cylinder when the car or cage is to be raised, and thus lifts the piston and its load. We understand these elevators are used to a considerable extent in Cincinnati, but so far, none have been erected here. The principle will be instantly recognized by our engineering readers as an old one, but we believe the exhibitor has some novelties in the details which we had not opportunity to examine.

Time and our programme did not allow of justice being done to the agricultural machinery exhibits; this however shall be remedied in the review of next year's Exposition, which we promise shall be still more exhaustive and complete. This opportunity must not be lost, however, of protesting against the want of enterprise among our Western farmers, as seen in the fact that not a single steam-plow was exhibited; mowers and reapers, harvesters and threshing machines, in abundance, but no steam plows, although these implements are in constant use and increasing demand in the countries of Great Britain, Belgium, France, and Germany. On this subject we hope shortly to write and explain the economy in the use of steam-plows over the horse plow. As much opposition, even more in fact, was once manifested against the mowers, reapers, and harvesters which are now in constant use all over the country.

Our review is now completed, and though we cannot say that every mechanical exhibit has been described, it can safely be affirmed that every important machine or invention has received a notice.

Though we dislike to boast, preferring to let our work show for itself, we feel that with some degree of pride, we may in this instance call the attention of the readers of the ENGINEER, ARCHITECT, AND SURVEYOR, to the carefully prepared Supplement to No. 7, herewith presented to them. Every article herein described was thoroughly and critically examined by one of the conductors of this journal, who, to a thorough preliminary training in class-room and shop, as a mechanical engineer, has added years of actual professional experience; and the conductors of this journal claim, in this case, the best prepared and most truthful and accurate description of mechanical exhibits ever submitted to the American public. Not a line has been written in the interest of any manufacturer, but the entire outlay of time, labor and expense is our own. Our columns are open for the description of machinery of all kinds where we can recognize real excellence or novelties of general interest, and care will be exercised to do full justice to all such; and, as we can confidently assert that our journal is now circulated as widely, if not more so, than any similar technical paper in this country, we submit the question to manufacturers aud dealers in machinery, whether they can find any more profitable medium through which to advertise judiciously, effectually and cheaply, than the ENGINEER, ARCHITECT AND SURVEYOR.

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